APRIL 1960

Heating Piping & Air Conditioning

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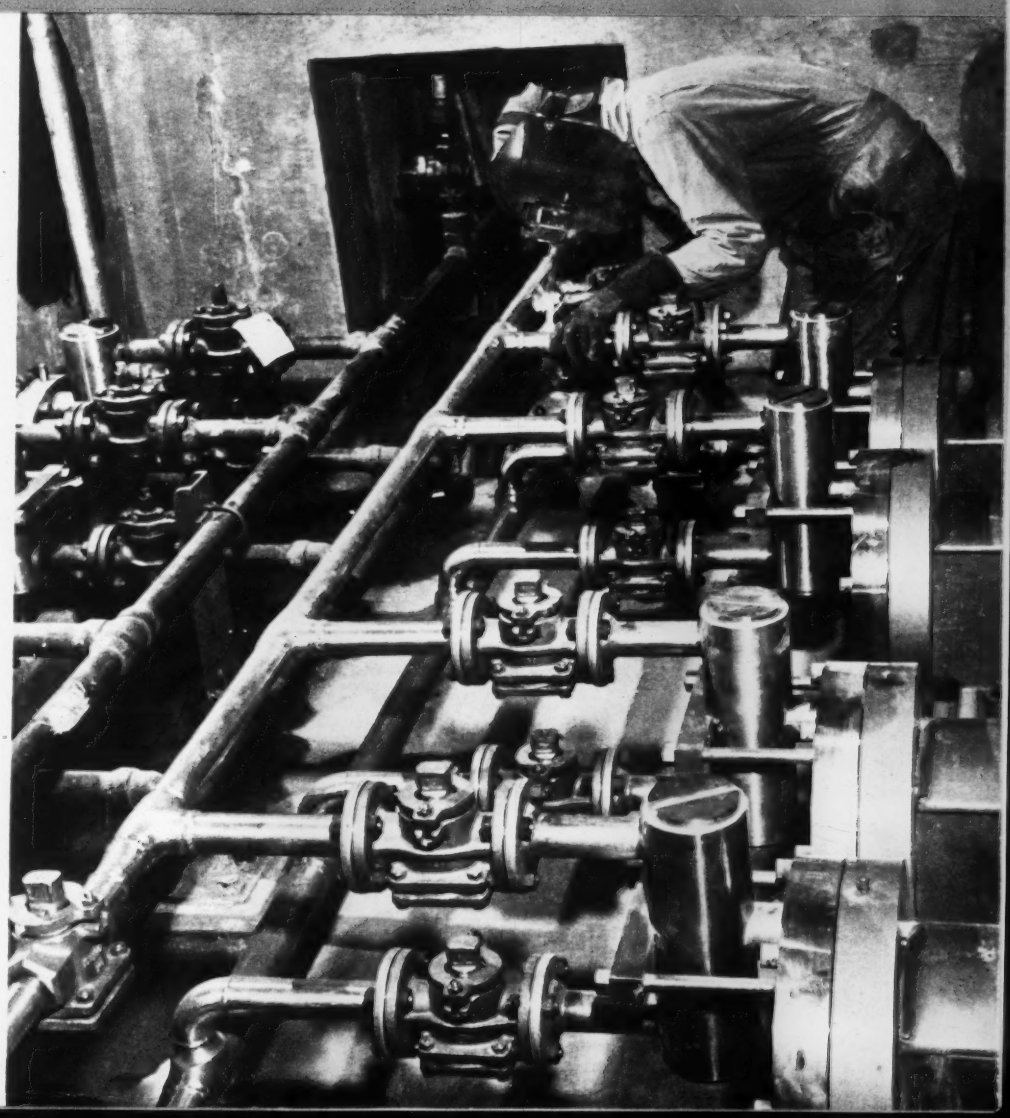

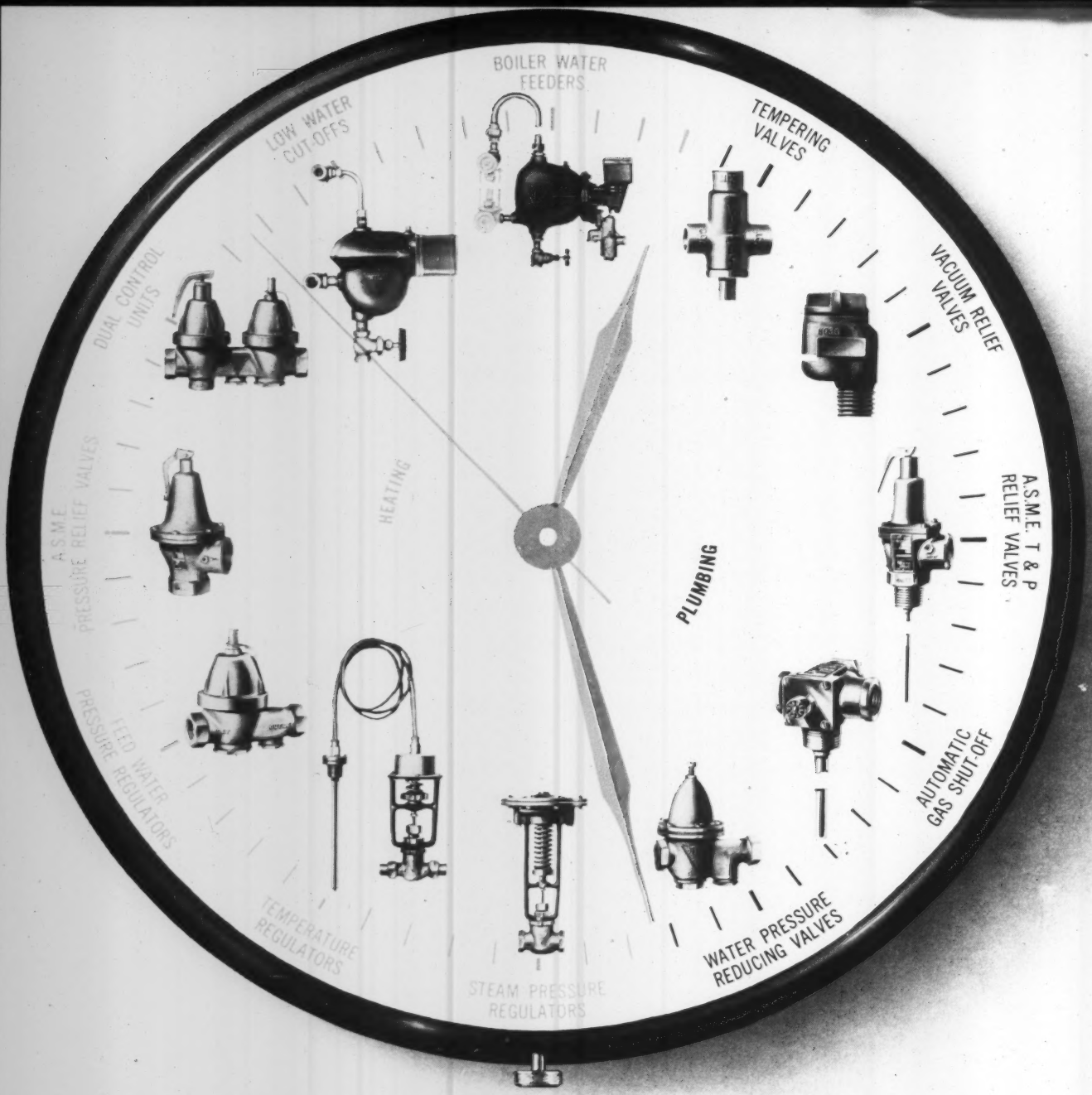

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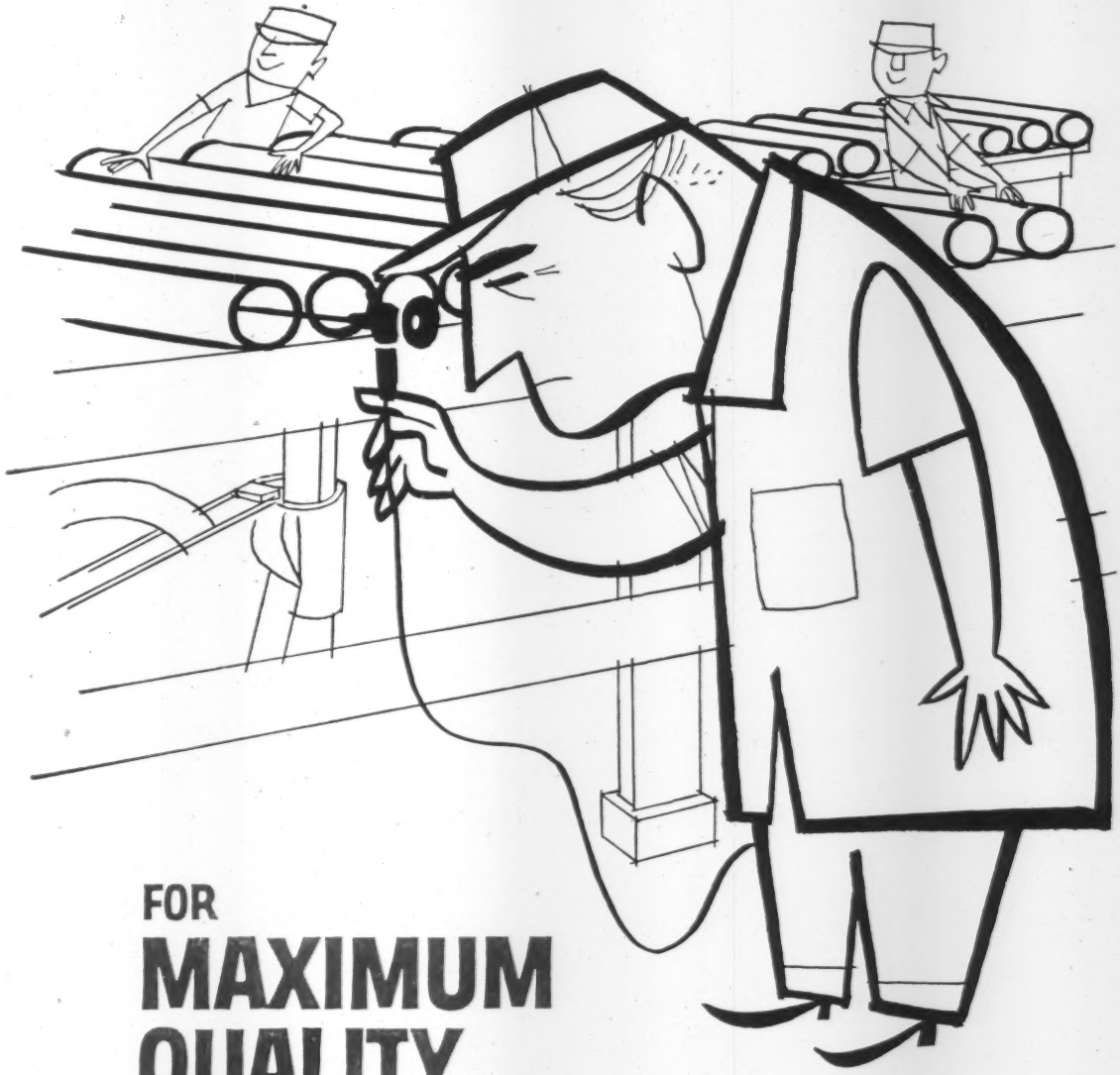

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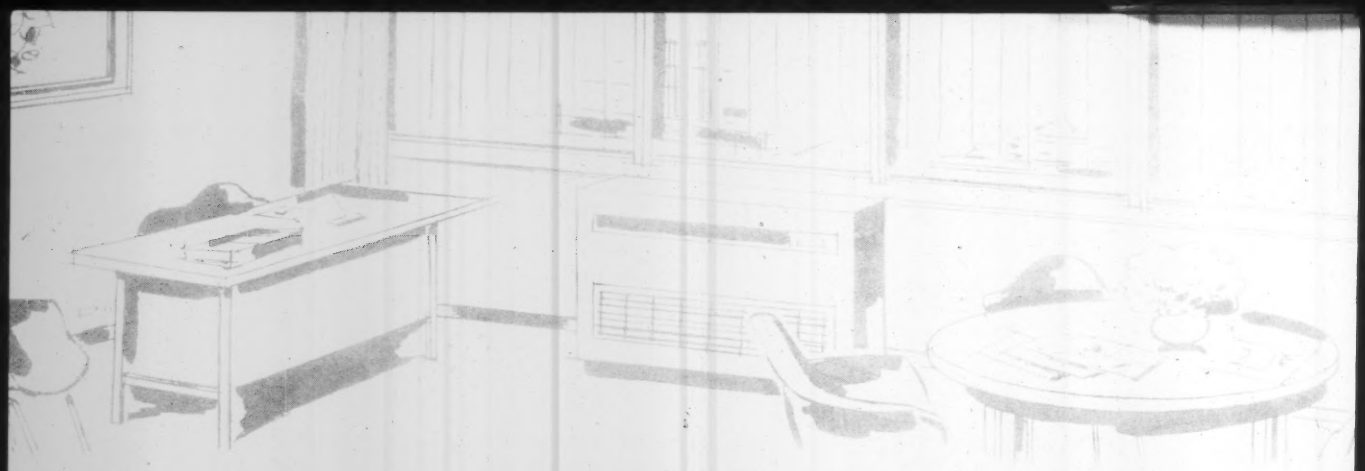
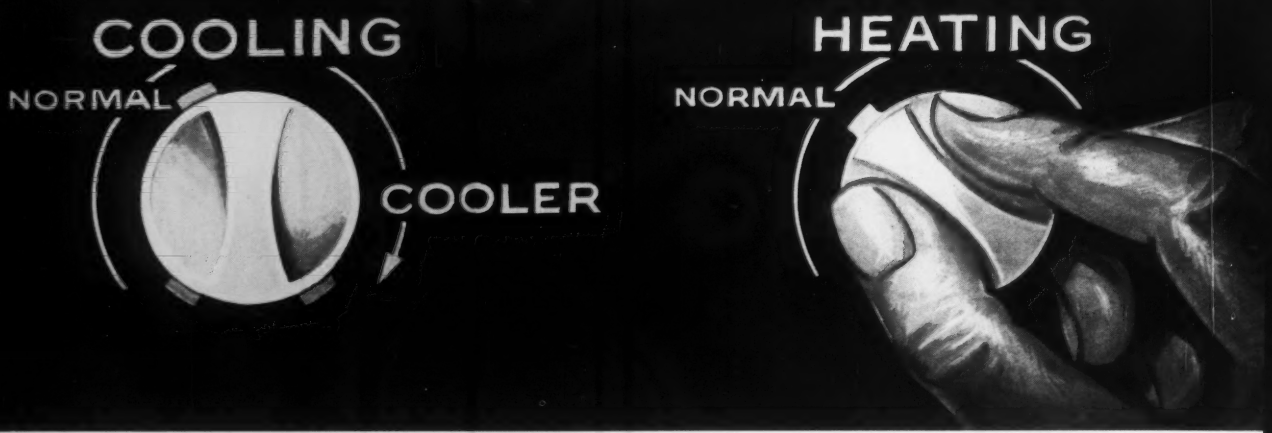


THE NEW CONCEPT IN HEATING AND COOLING



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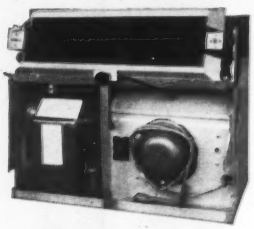
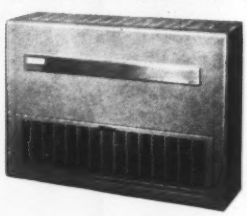
This modern way to air-condition saves you money right from the start. Attractive in-wall units can be economically installed a room at a time—*without* interruption of building occupancy. Webster Newports connect readily to existing heating systems—or a new all-electric model will tie in with electrical circuiting. An entire building can be air-conditioned in easy stages at savings up to 30% as compared to a central system installation. Let a Warren Webster man detail the savings—and convenience—*you* can look for with Webster Newport heating and cooling.



COOLING BY CHRYSLER AIRTEMP

EQUIPPED WITH CHRYSLER'S HEAVY-DUTY COMMERCIAL COOLING CHASSIS



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HEATING • COOLING

CAMDEN 5, NEW JERSEY

Heating, Piping & Air Conditioning

FOR CONSULTING ENGINEERS, MECHANICAL (HEATING, PIPING, AND AIR CONDITIONING) CONTRACTORS, ENGINEERS WITH PLANTS AND BIG BUILDINGS

VOL. 32, NO. 4 APRIL 1960

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Published monthly by the Keeney Publishing Co., 6 N. Michigan Ave., Chicago 2, Ill. Telephone: STate 2-6916. Subscriptions: U.S. and possessions, $3.00 per year; Canada, $5.00 per year; Cuba, Mexico, Central America, South America, Spain, $6.00 per year; other, $7.00. Current copies, 75c each; back copies, $1.00 each. January 1960 issue, $2.00 per copy. Member Audit Bureau of Circulations and Associated Business Publications, Inc. Heating, Piping & Air Conditioning is indexed regularly by Engineering Index, Inc., and Industrial Arts Index and is microfilmed by University Microfilms.

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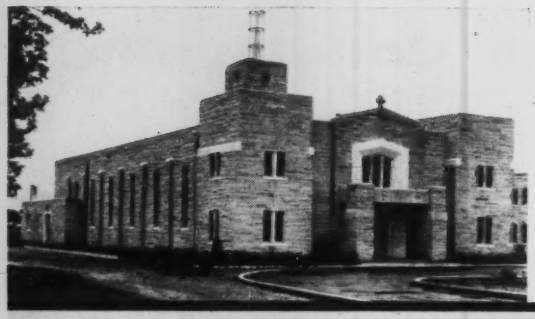
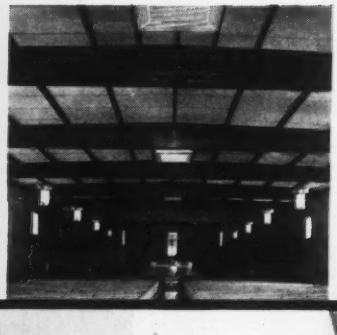
SECOND-CLASS POSTAGE PAID AT CHICAGO AND MENDOTA, ILL.

SUBSCRIBERS—*Change of Address*: Publisher needs five weeks' advance notice, mail address from current issue envelope, and new address with city postal zone number. Mail to . . . Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill., U. S. A. POSTMASTER: *When Magazine Is Undeliverable*: Send Form 3579 to Publisher at above address. Include city postal zone AND DATE *on last line* under mail address on envelope as our *key*.



as **quiet** as a church



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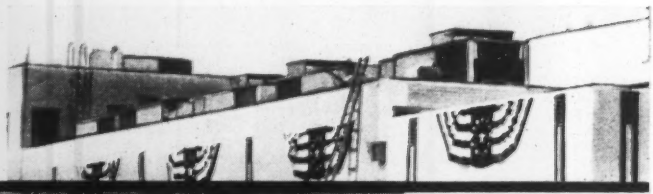

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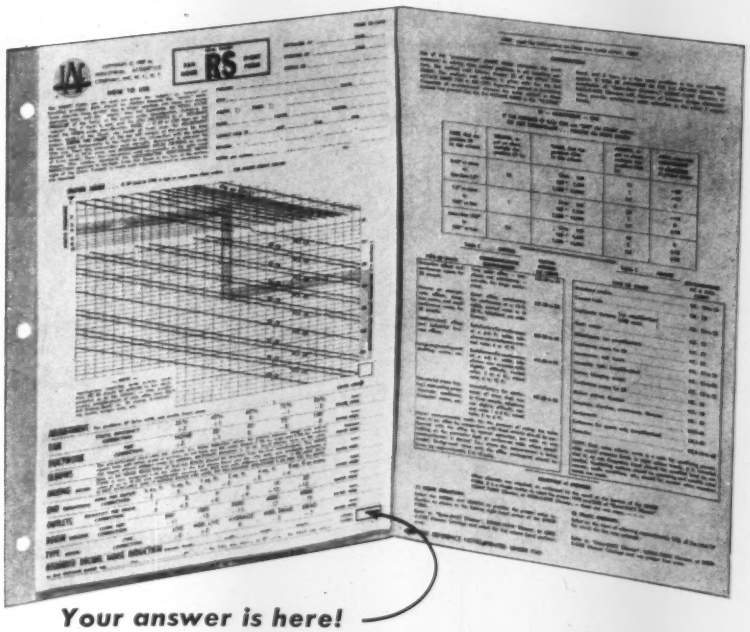
When you use the "SHORT FORM" for quickly and accurately* resolving noise problems in air handling systems

— Acoustical knowledge is not needed!



Your answer is here!

The "SHORT FORM" is calculated for the 3rd Octave Band in accordance with the data and procedures recommended in the HVAC GUIDE. Nine simple steps, taking only a few minutes, give you the needed Noise Reduction in decibels from which you can select the "package" silencers for all problems NC-30 through NC-55. Applicable to all silencers rated in terms of Noise Reduction as defined in the current HVAC GUIDE.

— may we suggest you specify ours and be sure.

*A recent paper on package attenuators states that their selection can be accurately made on the basis of the Third (150-300 cps) Octave Band alone.

Industrial Acoustics Company, Inc., Air Conditioning Dept.
341 Jackson Avenue, New York 54, N.Y.

☐ Please send.....copies of the "Short Form" @ $1.00 each (postpaid).
Check or money order enclosed. (for outside U.S. add postage for 6 ozs.)

☐ Send complete data on Silencers. ☐ Have representative call.

Name_____ Title_____

Company_____

Address_____

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Heating and year-round air conditioning in

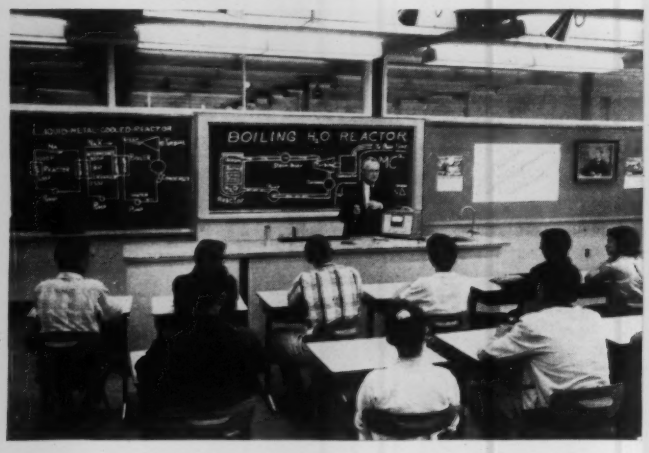
Air conditioned Library, round Building E, shown below.

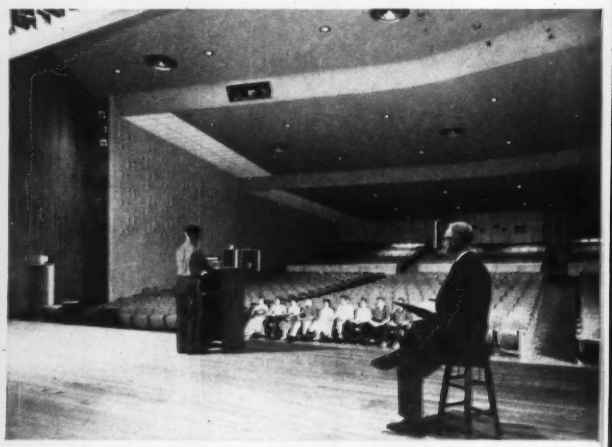
Linton Comprehensive High School
SCHENECTADY, N. Y.

Building A, is air conditioned Auditorium with choral, band and orchestra rooms; B) Cafeteria and multipurpose area; C) Gymnasiums, 3 large, 2 small; D) Core-Tech building with shops, also air conditioned administrative offices, Science, Arts, Family Living and Commerce departments; E) Air Conditioned Library; F) Academic classrooms.

Planned enrollment: 1800. Grades housed: 10th, 11th and 12th. Area 258,157 sq. ft. Construction Cost: $4,326,130.

Schenectady (home of General Electric Co. a pioneer in nuclear power plants) is justly proud of LINTON'S excellent science department. (d-3)





new LINTON HIGH SCHOOL regulated by

POWERS

Pneumatic system of Temperature Control

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Mechanical Engineer:
E. R. GRITSCHKE & ASSOC., INC.
Chicago, Ill.

Heating and Air Cond. Contractor:
TOUGHER HEATING & PLBG. CO.
Albany, N. Y.

"Plan a School that will still be functional in the year 2000"

. . . that was the challenge faced by the educational, architectural and engineering planners of Schenectady's much discussed Linton High School. One of the important innovations here is the year-round air conditioning in the Core-Tech building D, shown on opposite page, also the Auditiorium A, and the round Library building E.

Proper thermal environment is a valuable aid to effective teaching and learning. The flexibility of the Powers temperature control system installed at LINTON meets the demands of varied types of activity and occupancy in all seven buildings.

Air Conditioning, heating and ventilating systems are regulated from Powers Control Center located in the boiler room. See photo below at right.

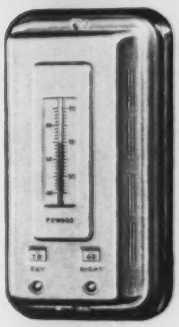
Day control for the air conditioning systems during the cooling season consists of dew point control for the chilled water coils with individual reheat mixing damper control for each zone controlled from a zone thermostat.

Night control of the air conditioning systems provides reduced room temperatures during the summer "night" cycle when the buildings are unoccupied, with a minimum of refrigeration. This feature is designed to provide precooling and reduced start-up load.

A Powers MASTROL System controls the hot water heating system plus individual room control of convectors in critical areas.

In the Year 2000, the Powers temperature control system at Linton will likely still be functional. Twenty-five to 50 years of dependable operation with a minimum of maintenance is often reported by users of Powers control.

In Your New School make sure taxpayers get the biggest return on their investment in accurate temperature control. Ask your architect or engineer to include a time-proven Powers Quality System of Control.



190 Powers DAY-NIGHT Thermostats here help prevent OVERheating in occupied rooms and are adjustable for lower economical temperatures during unoccupied periods.

216 Powers PACKLESS Control Valves are used on convectors and unit ventilators. They're labor savers, banish packing maintenance and will prevent damage from water leakage.

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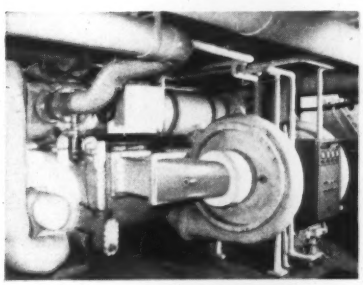
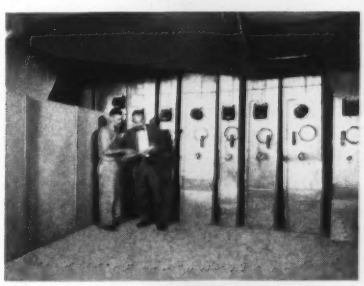
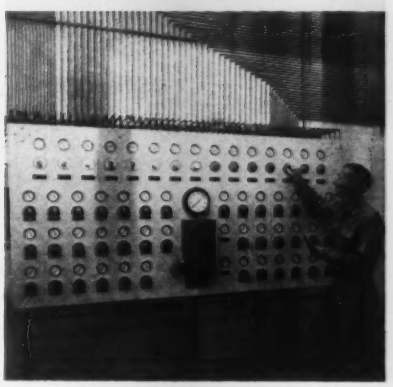
DEPT. 468, SKOKIE 6, ILLINOIS *Offices in 85 Cities in U.S.A. and Canada*
MANUFACTURERS OF THERMOSTATIC CONTROLS SINCE 1891







Left: 235 Ton Centrifugal refrigeration compressor has ample capacity for building D and library, or auditorium alone when other two buildings are not in use.

Right: Powers Control Center in boiler room. Center photo: one of 5 air conditioning systems and 9 of 68 Powers Sub-Master Thermostats controlling conditioned air to various spaces.

B.A.C.

COOLING TOWERS
EVAP. CONDENSERS

NOW TO 700 TONS

in single factory-assembled units

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LETTER FROM THE EDITOR

April 1960

Dear Reader:

How each of the 1228 guest rooms in the Boston Statler-Hilton hotel are zoned separately is explained by Lewis Smith on page 117. Separate hot and chilled water lines are run to each room unit and on each unit is a newly developed guest-operated valve. This valve admits either hot or chilled water to the coil depending on the temperature desired by the room occupant. The existing steam heating boilers in the hotel were utilized in the design of the air conditioning system. It was decided to install a combination of a steam turbine driven centrifugal compressor exhausting steam into an absorption refrigeration unit. When operating at or near full capacity this arrangement produces a low rate of steam per ton by using the steam in two stages. The hotel management is very well satisfied that they have invested in a system that is giving them good performance with reference to both guest comfort and economy.

Why stainless steel piping systems perform as they do is explained on page 120 by Arthur C. Wicker. He describes the three main types of stainless steels and explains how the various chemical compositions and alloys affect the corrosion resistance properties and other advantages associated with this type of piping material. He also presents a cost comparison of the various types of stainless steel for pipe, welding fittings, and flanges in which he has taken Type 304 stainless steel as the basis.

A good report on present-day bidding practices is given by E. W. Klein, Jr. in his article on page 124. He explains the dangers of the "low-man-gets-it-philosophy" and how this is igniting a cost-cutting chain reaction throughout the heating, piping, and air conditioning industry. We need to upgrade our industry, he points out, by stressing customer relations and approaching each new job with a fair proposal. Through this concentrated and cooperative effort the entire situation can be improved.

Vertical zoning of the hot water heating system in a new 40-story apartment building was decided as the answer by George T. Lang, consulting engineer, who explains why and how the system was designed and installed in his article on page 128. Careful studies were conducted during the design, and through these it was determined that the system should be a downfeed hot water system which delivers the hot water horizontally above each zone. The water is then returned through inverted return mains at the lowest level in each zone. More than 1200 cast iron radiators are recessed into exterior walls to serve the 217 apartments.

Another phase of the subject as to how to prevent corrosion of copper and copper alloy tubing in heat exchanger and piping systems is presented this month by Dr. Obrecht and Dr. Quill on pages 131 through 137. This article explains how several systems at Michigan State University were monitored by test units to determine the effects of water treatment, temperature, and velocity under actual field operating conditions. The authors observed both pitting and impingement types of corrosion in these test panels, and they point out how the degree and type of water treatment is an important factor.

Cooling tower packings can influence the heat transfer characteristics as has been proven in tests on five different types at the Texas Engineering Experiment Station. The results of these studies are reported in the article by Wesley W. Smith and Glenn F. Hallett on page 143. The differences are quite significant and are attributed to the amount of splash area caused by each packing material.

Air conditioning a new garment plant with four 40 ton packaged units was decided after considering all the factors as explained by J. W. Orr in his article on page 146. Winter heating is provided by gas-fired duct heaters installed in the air duct distribution system connected to the four packaged units. An immediate increase in employee efficiency and morale was observed shortly after the new plant began operation.

How to size and locate orifices for measuring liquid flow in piping systems on page 150 contains several sets of helpful curves developed by John P. Johnston, the author. The graphical solutions presented apply specifically to water throughout the temperature range of 40 to 450 F. The author shows in this article how proper sizing and location of an orifice in a water line to a cooling tower, for instance, can control the flow which in turn will improve the performance. Several examples are given including suggested recommendations for locating the orifice after the size has been determined.

In the design and installation of nuclear piping systems several questions have developed that cannot be directly answered by referring to the Code for Pressure Piping. The Piping Code Committee has interpreted the Code for five such cases and these are given on page 159. As additional cases are made available they will also be presented in our pages.

The importance of providing adequate makeup air for industrial ventilation applications cannot be overemphasized. During winter this makeup air must be heated to avoid discomfort to the occupants. Using direct fired heaters is one way to do this. How to size these heaters and how to install and operate them is explained by M. H. Stern on page 163.

Multiple-leaf dampers are commonly used in air distribution systems to control air volume. If the damper is to function properly, knowledge of the damper's wide open pressure loss and its ability to control the air flow is essential. E. J. Brown, author of the HPAC Engineering Data File on pages 167 through 178, presents valuable pressure loss data and explains how to apply this information to determine the degree of control that might be expected. Pressure loss data for sizing face and bypass dampers to obtain equal air volume when either is wide open are also reported.

Question of the Month is on pages 110 and 112 and two interesting answers are given to the question about controlling a central heating plant for a multi-building installation.

The HPAC Data Sheet is on pages 157 and 158 and two nomographs are presented which permit an accurate and convenient determination of fan air flow rates.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

1000 TON CAPACITY PLANT

...air conditions Des Moines newspaper building. 375,000 c.f.m. air circulation!

AIR CONDITIONING MILESTONE

DES MOINES—The combination 13- and 4-story Register-Tribune building is the only large newspaper publishing plant to be successfully air conditioned throughout from a single air handling unit.

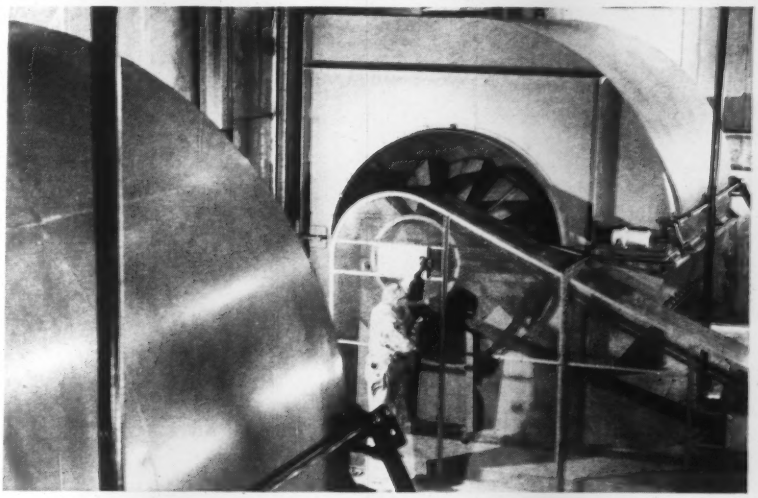
WIDE TEMPERATURE RANGE

In addition to fitting duct work into an almost impossible structural situation, the engineer was faced with widely varying room temperatures that result from the amazing variety of operations performed in a newspaper plant. Under one roof and in close proximity are hot stereoptyping operations, typesetting, darkroom facilities, wire service functions as well as office areas where humans work feverishly to satisfy the news demands of ever-humming, ever-hungry printing presses.

CHICAGO BLOWERS CIRCULATE 375,000 C.F.M. OF AIR THROUGH 1½ MILLION CUBIC FT. AREA

"One of the toughest problems," according to Mr. Wm. E. Nanes, consulting engineer, "was the cool air circulating fans."

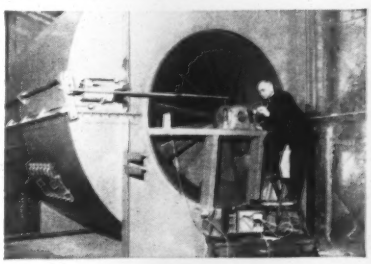
"The Register-Tribune people specifically requested the quietest fans available. It turned out that Chicago Blower Corporation could meet our needs on both counts. They had the capacity we wanted and their special hollow-sectioned air foil blade construction made the fans surprisingly quiet."



Two huge Chicago Blower centrifugal airfoil fans handle 375,000 c.f.m. of air in supplying cool, conditioned air throughout the newspaper plant and office areas. Special "Chicago" aerodynamic fan blade design keeps noise level at an absolute minimum.

92% EFFICIENCY WITH LESS POWER

Two Chicago Blower fans, whose housings are 15' high, were used. Each fan rotor is over 7' in diameter and weighs 3000 pounds. Because the blades are aerodynamically designed, similar to an airplane wing, eddy currents responsible for turbulence and noise are virtually eliminated. Fan efficiencies are an amazing 92% and they operate on less power. Noise level over similar capacity units is reduced as much as 40%.



Chicago Blower makes it standard procedure to give all large blower installations a final field balancing.

CHICAGO BLOWER ENGINEERING ASSISTANCE ALWAYS AVAILABLE

Chicago Blower plant and field engineers are always on call to assist firms working on heating and ventilating problems. They bring to any job a wealth of time-, trouble-, and money-saving information gained on thousands of installations.

7207

CHICAGO

CHICAGO BLOWER CORPORATION

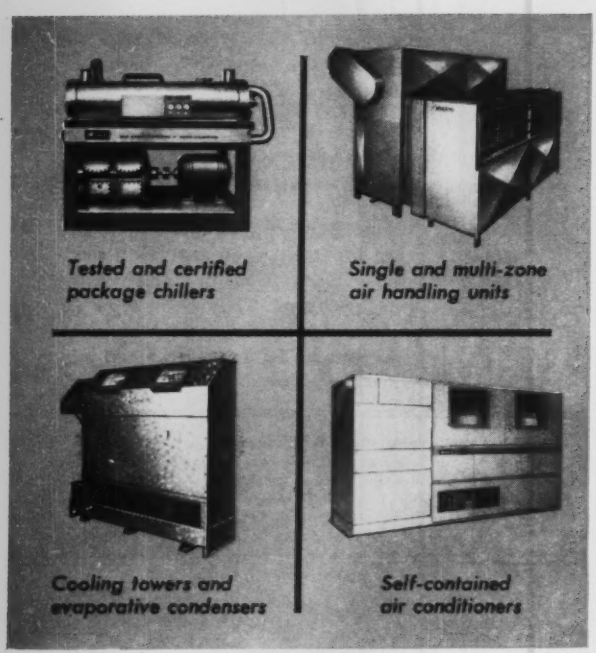
9869 Pacific Avenue • Franklin Park, Illinois

Want all the facts about this aerodynamically-designed fan? Ask your "Chicago" field engineer for a copy of Bulletin A-103. You will find him listed under "Fans," "Blowers," or "Ventilating Equipment and Supplies" in the YELLOW PAGES of your phone book. If you prefer, write or call direct and complete information and service will be provided.

Acme . . . the **practical** approach to

The First National City Bank of New York
. . . International Airport Branch

International Showcase of and comfort


Tested and certified package chillers
Single and multi-zone air handling units
Cooling towers and evaporative condensers
Self-contained air conditioners

Designed for the "Jet Age" by Skidmore, Owings & Merrill, this striking new First National City Bank Branch is located, appropriately, at New York's International Airport. And with its clean, modern architecture . . . its spaciousness, lighting and air conditioning . . . its handsome appointments and up-to-the-minute equipment . . . Citibank's International Airport Branch is truly an impressive showcase of banking efficiency, convenience and comfort.

MANUFACTURERS OF QUALITY AIR CONDITIONING AND REFRIGERATION EQUIPMENT SINCE 1919

air conditioning

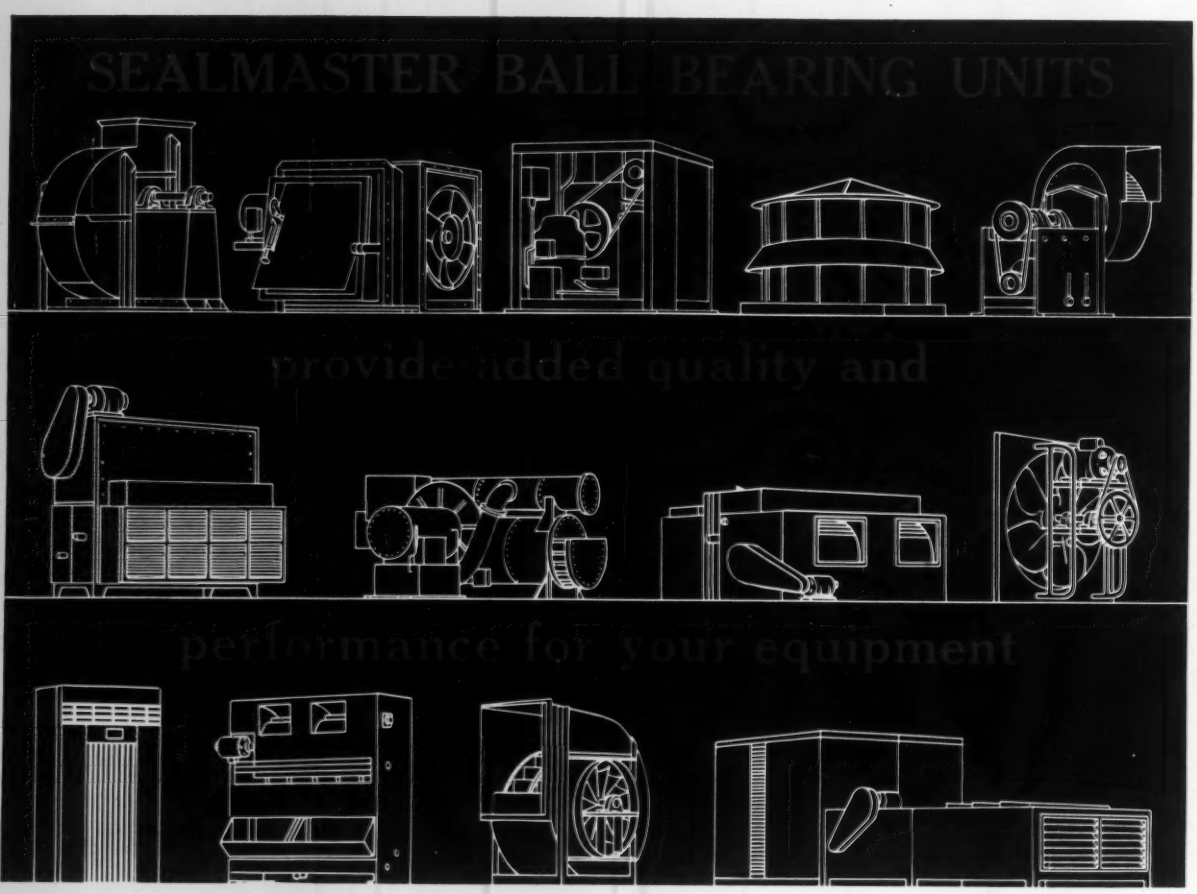
banking efficiency, convenience... conditioning (by Acme)

Headlining the comfort story . . . air conditioning by Acme. It's a story that rates headlines, too. Start with the fact that, per dollar invested, Acme-system equipment delivers the best return in cooling capacity and efficiency on the market today.

Then consider a few of the many other Acme advantages... *compactness and light weight*, saves valuable floor space, reduces building structural requirements (a case in point: installation at International, where Acme's unit was one of few that would fit into space available) . . . *factory "packaging"* eliminates on-the-job assembly, cuts installation costs . . . *easily accessible controls* facilitates inspection-maintenance, keeps service time and expenses to a minimum.

Finally, a suggestion . . . get the whole story. Acme advantages are easy to prove . . . proof is readily available from your nearby Acme sales engineer.

Acme INDUSTRIES, INC.
JACKSON, MICHIGAN

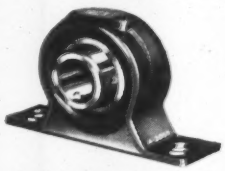


SEALMASTER Ball Bearing Units give a decided quality advantage at no premium in price. Exclusive SEALMASTER engineering features are designed to provide years of efficient performance. SEALMASTER'S diversified lines of bearing units enables you to meet all types of bearing applications and specific mounting arrangements. Whatever your bearing requirements may be, with regard to quality, performance, load or economy, you'll find SEALMASTER has it. For full information on SEALMASTER Ball Bearing Units, including the new low cost "L" Series Units and "L" Series Units with contact seals, call your SEALMASTER factory sales representative or distributor, or write direct to the factory.

Normal-Standard-Medium Duty
PILLOW BLOCKS

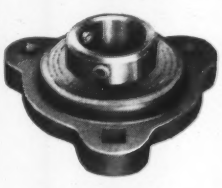
Standard-Medium Duty
FLANGE UNITS

RUBBER MOUNTED
CARTRIDGE UNIT



RUBBER MOUNTED
PILLOW BLOCK

WRITE FOR
CATALOG 454
and BULLETIN 359



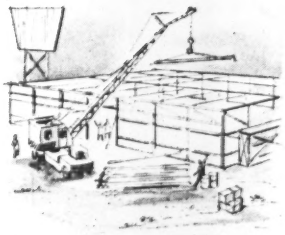
LF FLANGE UNIT

SEALMASTER

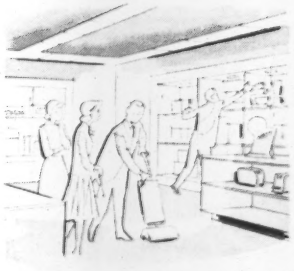
BALL BEARING UNITS

SEALMASTER BEARINGS A division of
STEPHENS-ADAMSON MFG. CO.
47 Ridgeway Ave. • Aurora, Illinois

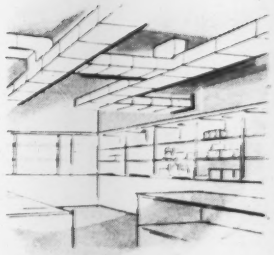
PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI • BELLEVILLE, ONTARIO



One-story construction?



Floor space valuable?



Don't want long runs of ductwork?

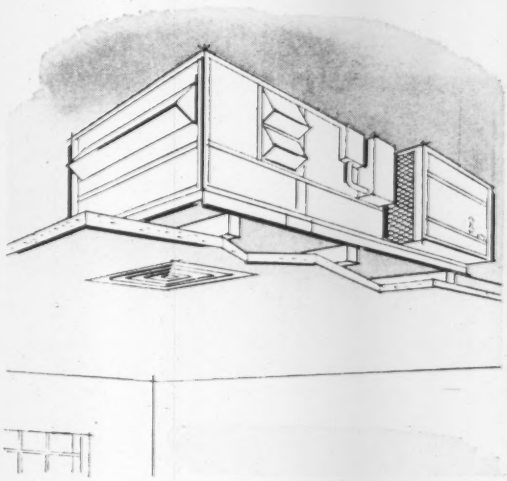
9 times out of 10 this is the most economical way to heat and cool a one-story building!

With the new Carrier Commercial Weathermaker*, year-round air conditioning can be designed and installed more economically than ever in one-story commercial or industrial buildings. It isn't necessary to give up an inch of valuable floor space, because this Weathermaker unit installs on the roof. And it isn't necessary to install expensive and unsightly ductwork, because the unit connects directly to a ceiling air grille. Notice the application here.

This unit is also designed to install with a minimum of time and trouble. It needs no water, no refrigeration piping, no charging with a refrigerant. One or more units can be installed as required, and with the following capacities: 7.5 tons of cooling and 200,000 Btus of heat . . . or 10 tons and 250,000 Btus. What's more, the motor-compressor is protected by a 5-year warranty.

For complete details about this Carrier Commercial Weathermaker, call the Carrier distributor near you. He's listed in the Yellow Pages. Or write Carrier Corporation, Syracuse 1, N. Y.

*Reg. U. S. Pat. Off.



This Carrier 48B Commercial Weathermaker puts both the heating and cooling plant in the most economical of locations—the roof! It is supplied ready for fast one-unit installation. It is factory charged with refrigerant, equipped with refrigeration piping and quickly connected through the roof to a ceiling air grille.

BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

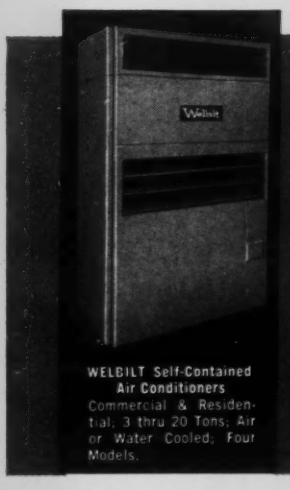
Carrier

MEMO

TO: Ted Coon, District Manager
St. Louis Territory:

Ted:
Here's the Welbilt story that's attracting distributors all over the country.
New subsidiary, old hands, good facilities, on the move... definitely the line to watch.
A solid line - complete, guaranteed, backed by technical experts. No "fast buck" stuff...
we're here to stay.
Clean-cut marketing policy, protection for all resale groups, plenty of technical and promotional assistance... a high profit line for both dealers and distributors.
Particularly promising items illustrated.
That's the story thus far... a very solid one for my money. Glad you're with us. Will keep in touch.

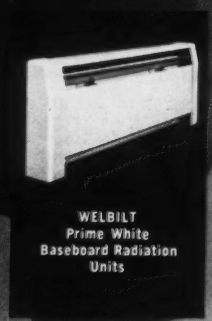
Pete Dalton



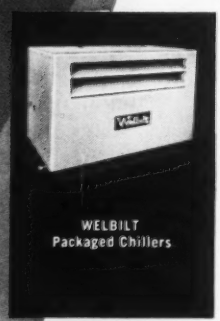
WELBILT Self-Contained Air Conditioners
Commercial & Residential, 3 thru 20 Tons, Air or Water Cooled; Four Models.

WELBILT Series VGF Gas-Fired Hi-Boy Furnaces
Residential & Small Commercial; 6M to 120M BTU Output.

WELBILT Heat Pump



WELBILT Prime White Baseboard Radiation Units



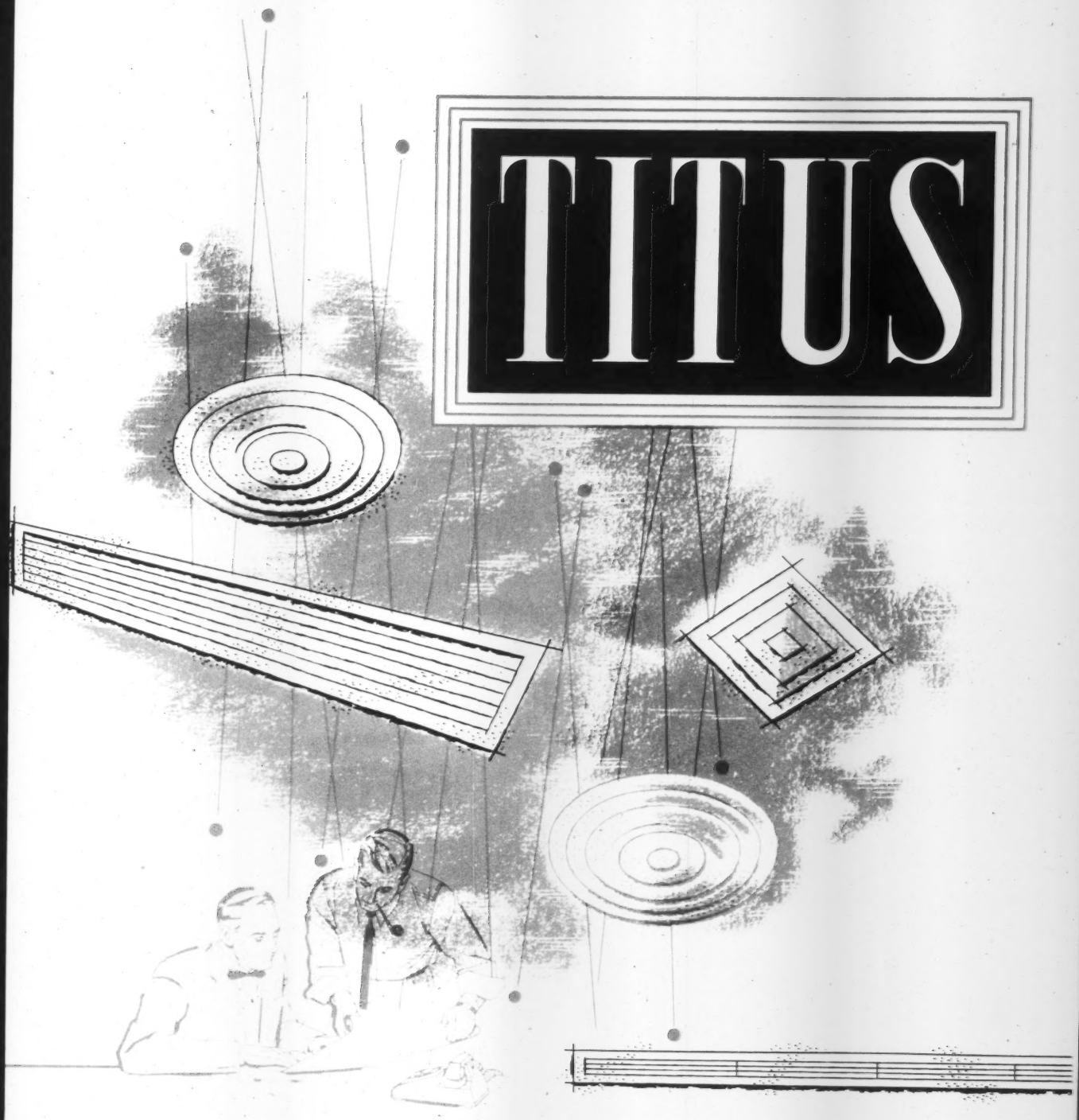
WELBILT Packaged Chillers

WELBILT Attic Stowaway Air Conditioners

America's newest line of high-quality Air Conditioning, Refrigerating and Heating Equipment. Illustrated Catalogs on request.

SELF-CONTAINED AIR CONDITIONERS • HEAT PUMPS • AIR AND WATER COOLED CONDENSING UNITS • WATER AND AIR COOLED PACKAGED CHILLERS • COOLING TOWERS • EVAPORATOR CONDENSERS • GAS FIRED HI-BOY FURNACES • GAS FIRED HORIZONTAL FORCED AIR FURNACES • GAS FIRED BOILER UNITS • CLOVERDALE HOT WATER BOILERS • RESIDENTIAL OIL FIRED BOILER BURNER UNITS • COMMERCIAL OIL FIRED BOILER BURNER UNITS • COUNTERFLO, SUSPENDED, HI AND LO-BOY OIL FIRED WINTER AIR CONDITIONERS • COMBINATION HEATING AND AIR CONDITIONING UNITS • UNIT HEATERS • DUCT HEATERS • RESIDENTIAL RADIATION BASEBOARD

Welbilt AIR CONDITIONING and HEATING CORP.
SUBSIDIARY OF WELBILT CORPORATION
Farmingdale, New Jersey



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TITUS MFG. CORP. — Airfoil REGISTERS, GRILLES CEILING DIFFUSERS

WATERLOO, IOWA

Gentlemen of the Air Conditioning Industry:

The success of any business depends greatly on the men who represent that firm in the field. It is their knowledge, hard work and service which help form a solid foundation for acceptance of the company's products...and hence growth of the company itself.

The wonderful co-operation, outstanding service and hard work of these representatives have helped give Titus air distribution products their great acceptance throughout the nation...and made the Titus name one of the best known in the industry.

We are proud to be served by such outstanding men in the air conditioning field.

May we suggest that if you have an air distribution problem...or desire something new and different in air distribution product design, that you contact your local Titus representative, pictured here. His knowledge and many years of experience...backed by the tremendous engineering, manufacturing and laboratory facilities of the Titus company, are your assurance of OUTSTANDING SERVICE.

Very sincerely,

Don and Bob Titus

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A COMPLETE LINE OF TITUS *EAGle-Line EXTRUDED ALUMINUM* AIR DISTRIBUTION PRODUCTS . . .

- Sidewall Supply Air Grilles and Registers
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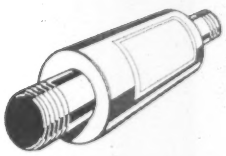
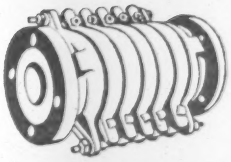
- Ceiling Grilles
- Slim-Line Diffusers
- Matched Linear Diffusers for Ceilings, Sidewalls, Floors
- Linear Convector Enclosures
- Security Grilles & Brick Vents
- 1½", 2" and 4" Outside Louvers
- Penthouses

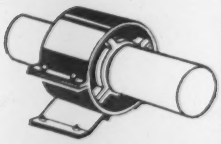
TITUS MFG. CORP., Waterloo, Iowa
Miami, Florida



FLEXONICS Model H Expansion Compensator —in sizes to 3", for pressures to 175 p.s.i., absorb 2" total pipe motion at each unit.



FLEXONICS Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



FLEXONICS Pipe Guides—a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.

FLEXONICS Model L Expansion Compensator—the sure, low-cost way to take up pipe and tubing expansion in baseboard heating systems.

INSTALL IT...
FORGET IT!

ENGINEERS ACROSS THE COUNTRY ARE SPECIFYING FLEXONICS MODEL L PACKLESS EXPANSION COMPENSATORS

You'll find FLEXONICS Model L Expansion Compensators written into the heating specifications for the finest, most modern buildings across the country. There's no substitute for their completely packless design, their easy installation, and the fact that they *never need maintenance!*

There's no easier or lower-cost way to take care of pipe and tubing expansion and eliminate water hammer noise, especially in baseboard convector installations. Install a FLEXONICS Expansion Compensator in minutes — forget it for the life of the building.

They have been proved in thousands of installations. Why not write them into your next job? Write today for cost data, and the name of your FLEXONICS representative.

Today—write for informative and helpful Catalog

EC-135

Flexonics
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EXPANSION JOINTS · METAL HOSE · SYNTHETIC HOSE · BELLOWS · AERO/SPACE COMPONENTS

A SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

Flexonics Corporation
1391 S. Third Avenue
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Please send me my personal copy of Flexonics Catalog 205, including full information on using Flexonics Expansion Compensators to absorb pipe movement.

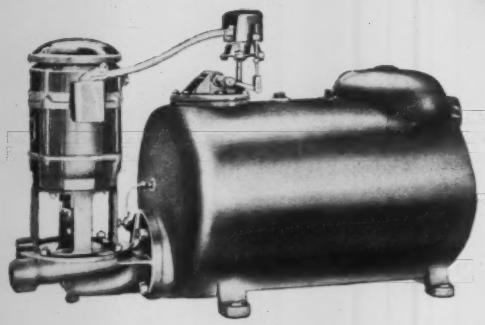
NO NEED FOR CUSTOM JOB

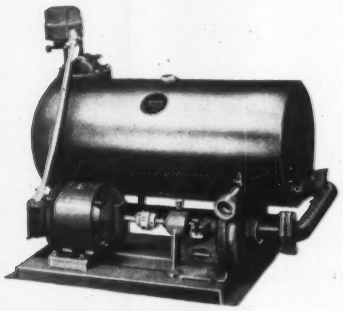
A standard type Skidmore Pump will meet the exacting requirements

4 ways . . . to improved pump performance!

TYPE "VC" PUMP

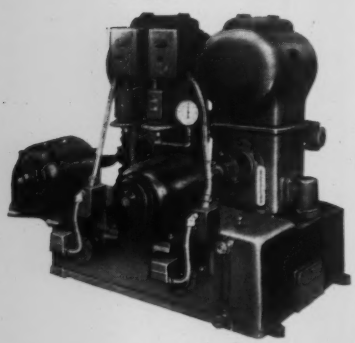
Furnished in single or duplex units. Bulletin 10-B





TYPE HS PUMP

Furnished in single or duplex units. Bulletin 14-B



TYPE CCVS PUMP

Three new single units, two duplex. Bulletin 21-C

VACUUM PUMP

Furnished in single or duplex units. Maintained efficiency. Bulletin 9-B

Let Skidmore assist you in your heating pump plans. Write for bulletins.

SKIDMORE CORPORATION

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Choose with Confidence!

ZURN SHOKTROL®

FROM PACKAGE TO TEE IN 1 MINUTE

No costly cutting, threading, or fitting. Zurn all-stainless steel Shoktrol water hammer arrestors are installed in seconds in any standard I.P.S. connection . . . easily . . . economically.

No clamps or brackets needed. They're ultra-compact and lightweight for self-supporting installation - - even in copper plumbing lines.

"Callbacks" kept to a minimum. Unique bellows, precharged with air, eliminate costly effects of water hammer for the life of your piping system.

FREE . . . SPECIFICATION AND SIZING DATA!

ZURN INDUSTRIES, INC.
Plumbing Products Div.
Erie, Pa. U. S. A.

Please send me the following NEW data:

----------SHOKTROL MANUAL, 60-2
----------"SHOKTROL-SIZER" Form 37 Adv.

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TITLE.....
FIRM.....
ADDRESS.....
CITY.....ZONE.....STATE.....

HP-1

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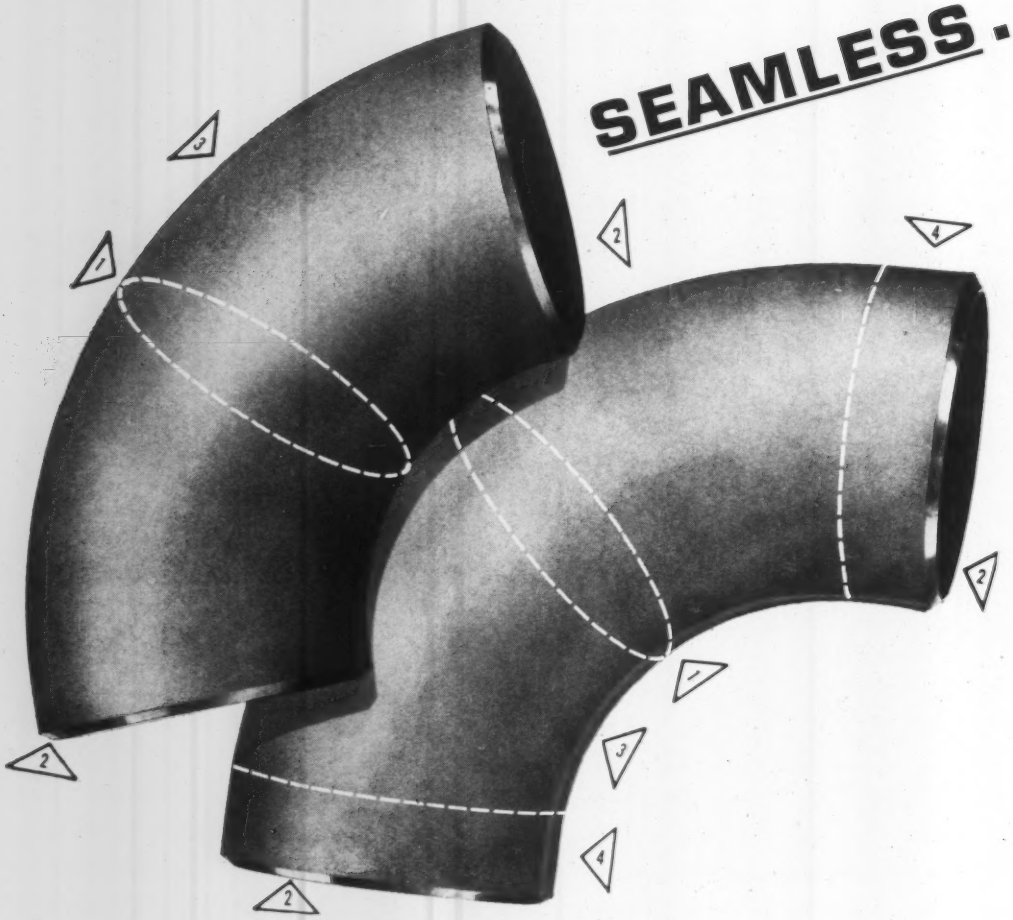
ZURN

A Step Ahead of Tomorrow
ZURN INDUSTRIES, INC.
PLUMBING PRODUCTS DIV.
ERIE, PA. U. S. A.

FREE... NEW!
ZURN
SHOKTROL MANUAL
"SHOKTROL-SIZER"

NOW...BOTH!

SEAMLESS.



1. BONUS . . . All fittings hot-coined in compression throughout entire length—dimensionally true to permit segmenting at any point. **2.** BONUS . . . Seamless and welded-type fittings with specially machined ends assure uniform thickness and diameters . . . ends that are circle-perfect, plumb and square. **3.** BONUS . . . Wall thickness and uniformity—greater than required by ASA Standards.
4. BONUS . . . Long Tangent bonus on welded-type fittings—NO EXTRA COST—saves pipe, simplifies lining-up, eliminates short welded stubs. 5951

..BY MIDWEST

NEW! The finest *seamless* welding fittings ever made. NOW—a hot-coined fitting, dimensionally accurate from end to end . . . fittings forged at controlled heat for superior metallurgical quality . . . with specially machined ends for quickest fit-up and welding! Produced by the newest and most modern equipment—combined with the latest technology in forging, sizing, heat-treating, and machining. Available in all sizes through 24″—long radius or short—90's, 45's, 180's.

WELDED . . . BY MIDWEST

Welded-type fittings, fully reinforced . . . especially "Long Tangent" bonus fittings . . . always available from stock in carbon steel through 36″ (to order through 48″)—same high quality as always. Also available from stock in wrought iron and chrome-moly. Fittings formed from plate and welded are ideally suited to unusual requirements—heavy wall (2″, 3″, 4″ or more) . . . Hi-Yield, Inconel, stainless, Hastelloy and all other weldable metals. Extra tangent lengths, reducing ells, and special fittings of all kinds are made best as welded-type fittings.

THE WORLD'S MOST COMPLETE LINE OF WELDING FITTINGS . . . sold through stocking distributors from coast to coast.

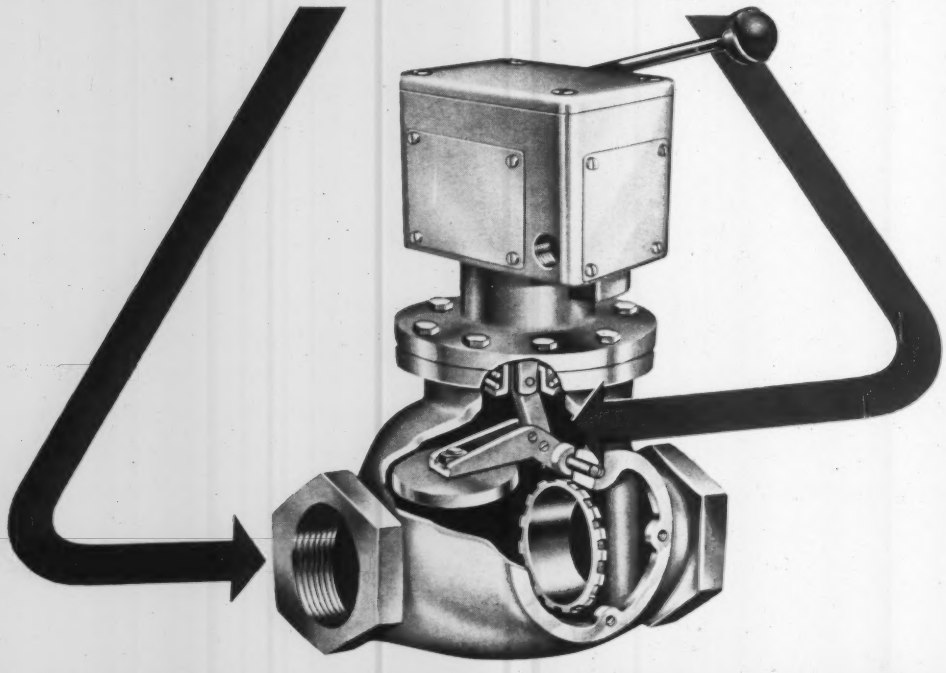
MIDWEST

Write for NEW brochure
SEAMLESS AND WELDED-TYPE
FITTINGS, No. 60-C

PIPING COMPANY, INC.
1450 South Second Street *St. Louis 4, Missouri*

Which of these major gas valve problems is yours?

CAPACITY? SAFETY?



THIS NEW GENERAL CONTROLS HI-FLO GAS VALVE SOLVES BOTH... AND MORE

Straight through flow provides maximum capacity — minimum pressure drop. Vertical seating prevents build-up of foreign matter on valve seat, and soft seat insures positive shutoff. Short 90° travel reset handle for easy opening *and* closing, manually. H-117 model incorporates dual release actuator, and fixed or adjustable opening speeds. Before you buy *any* high capacity gas valve, check this capacity table. You'll find your nearest General Controls factory representative in the yellow pages.

GENERAL CONTROLS

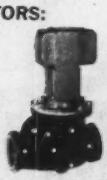
Automatic Controls for Product or Process
Glendale, Calif. • Skokie, Ill. • Quebec, Ontario, Canada
Nine plants — 44 factory branch offices serving the United States, Canada and Western Europe

COMPARE THESE GAS CAPACITIES

GAS CAPACITY — 1" DROP

PIPE SIZE (INCHES)	HI-FLO VALVE			CONVENTIONAL GLOBE VALVE
	CU. FT. HR.	MAX OPER. PRESS P.S.I.	Cv FACTOR	CU. FT. HR.
1 SCR	2000	50	37.8	920
1¼ SCR	2700	50	51.0	1370
1½ SCR	4000	50	75.6	1840
2 SCR	8000	25	151.0	3570
2½ SCR	12,900	15	244.0	4500
3 SCR	17,000	15	320.0	6600
4 FLG	27,000	8	510.0	8900
6 FLG	54,000	5	1020.0	17,800

CHOICE OF TWO ACTUATORS:

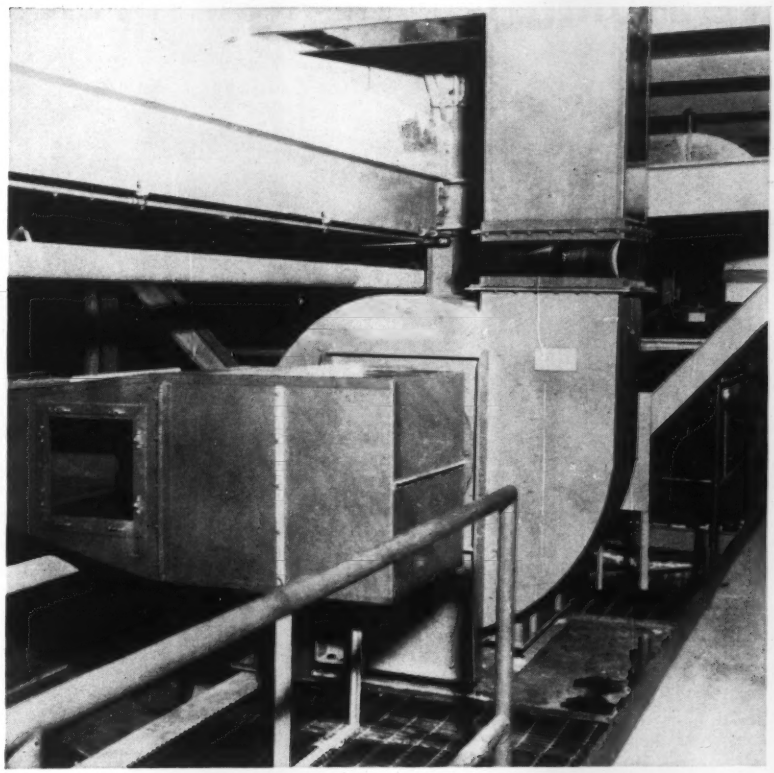


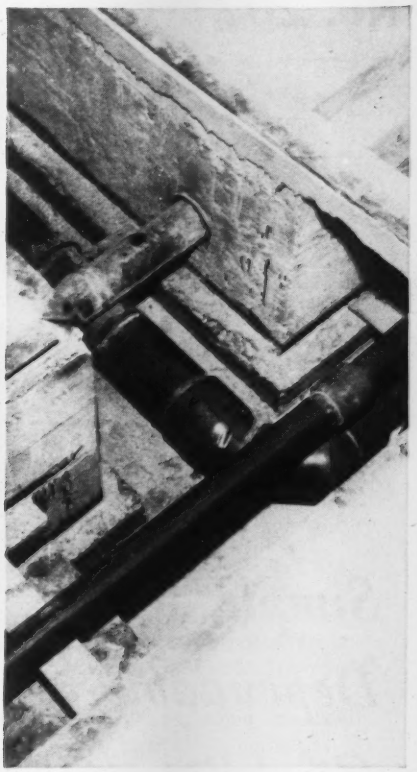
V-116 MANUAL RESET, with lever action—90° handle travel. Held open electrically, spring closed on power interruption.

H-117 HYDRAMOTOR, electric reset, with either fixed opening speed or adjustable opening speed regulated to design of equipment.

News about

B.F.Goodrich Chemical *raw materials*





Electrical manufacturer ends corrosion problem

. . . uses fume ducts and sewer pipe of Geon

This major electrical equipment manufacturer solved his maintenance problems and cut costs by installing ductwork and pipe made from Geon vinyl. Ordinary pipe or duct would create corrosion problems in no time —but Geon is unaffected by most causes of corrosion.

Sheet for duct use or pipe made of Geon vinyl is easy to use. Installation crews like it because it is so light in weight and easy to work with. Fittings, nuts and bolts of Geon vinyl are also available. Pipe can be joined by threading or solvent welding.

How can your plant gain from ductwork or pipe of Geon vinyl? Get more information today. Write Dept. GG-2, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

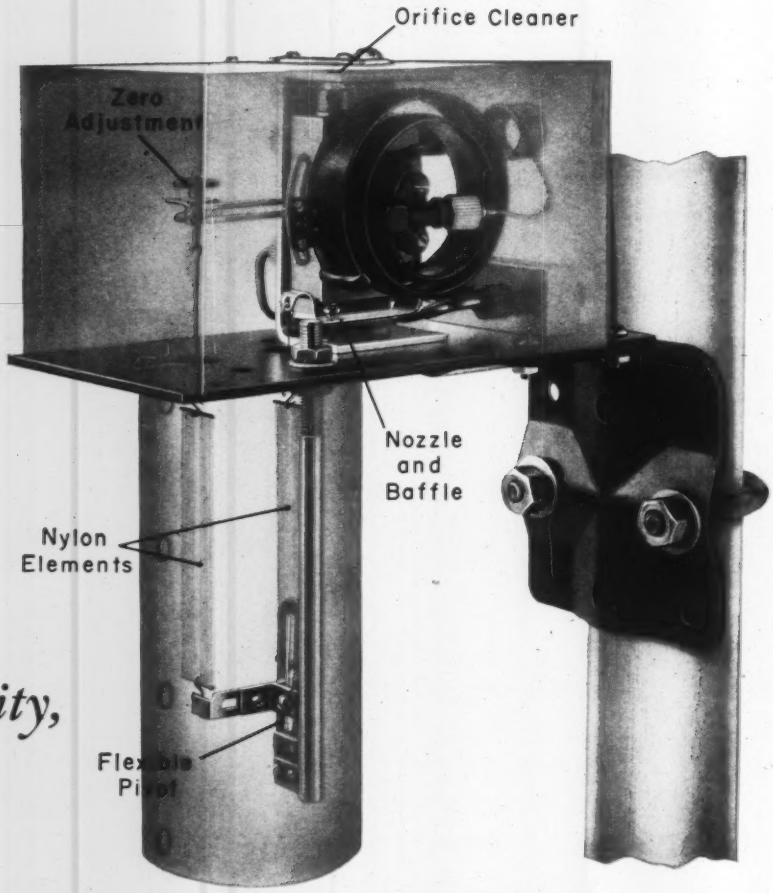
Geon VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

New FROM *Taylor*

No. 207T RELATIVE HUMIDITY TRANSMITTER



Phantom View of Room Model

Simple,
Dependable,
Good Repeatability,
Easy to Service!

A non-indicating, pneumatic, motion-balance transmitter, the No. 207T produces an air output pressure proportional to the relative humidity around the sensing elements, permitting a direct reading in the receiving instrument.

The dimensional changes of the two nylon sensing elements, in response to variations in relative humidity, operate a nozzle-baffle system to produce the 3-15 psi transmitter output signal.

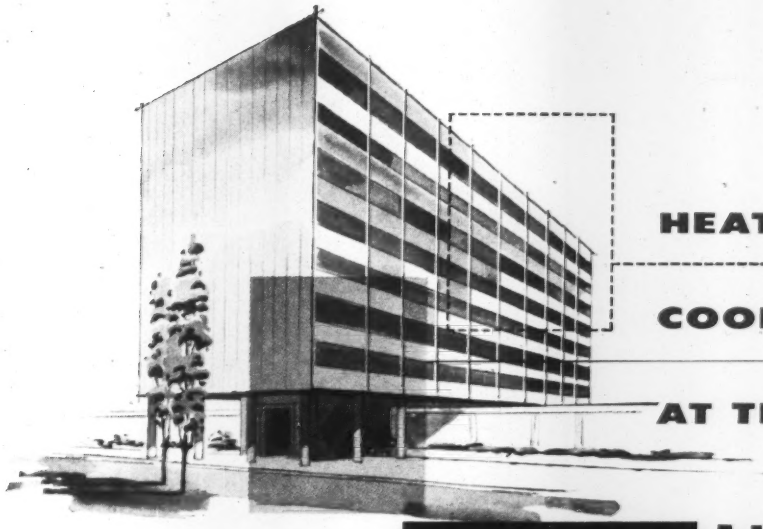
Easy to adjust. Zero setting can be checked by comparing the output with relative humidity determined by a wet and dry bulb hygrometer. Adjustment is by means of a knurled nut on the Bourdon spring take-off arm.

Easy to maintain. Nylon elements, nozzle-baffle system and Bourdon spring element are readily accessible. Stainless steel nozzle is easily removed for cleaning. Gasketed finger-tight connections make it simple to replace tubes. The 207T is designed for room or duct installation. Working range is 15 to 90% Relative Humidity at a constant dry bulb temperature.

♦ ♦ ♦

For complete specifications ask your Taylor Field Engineer, or write for **Bulletin 98338.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ont.

Taylor Instruments MEAN ACCURACY FIRST

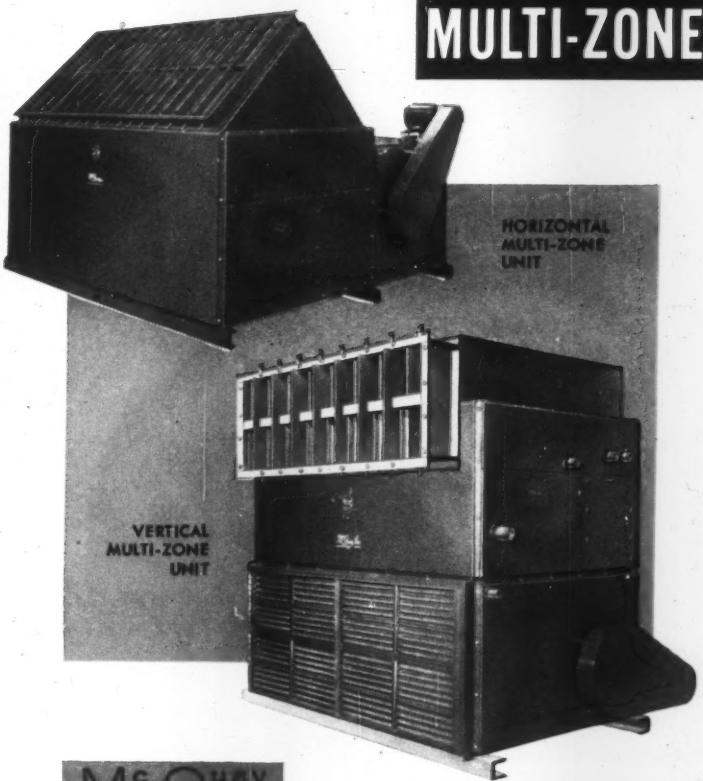


HEAT ONE SECTION

COOL ANOTHER—

AT THE SAME TIME

McQuay MULTI-ZONE AIR CONDITIONERS



You choose your own weather with McQuay "MC" Multi-Zone air conditioners—even to heating some sections of a building while you cool others. You can furnish balanced comfort simultaneously to different, determined areas with either filtered, cooled and dehumidified air; or filtered, heated humidified air—or a mixture of these in any desired proportion—at your command.

McQuay "MC" Multi-Zone air conditioning units are available in 11 sizes from 1370 cfm to 38,000 cfm. Each unit has a standard number of zones available from 6 on the smallest to 22 on the largest. All zones are interconnected by a single external connecting rod. A full line of accessories is available . . . preheat steam coils, filter sections, mixing boxes, humidifiers.

McQuay "MC" units, of course, feature the famous McQuay Ripple-Fin coils for highest efficiency and Dura-Frame "V" channel construction for strength and rigidity. When you use McQuay, you can be sure that engineering research and know-how have produced the finest, most efficient and dependable equipment available. McQuay, Inc., 1601 Broadway Street N.E., Minneapolis 13, Minnesota.

McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

THERE IS A DIFFERENCE IN PIPE FITTINGS

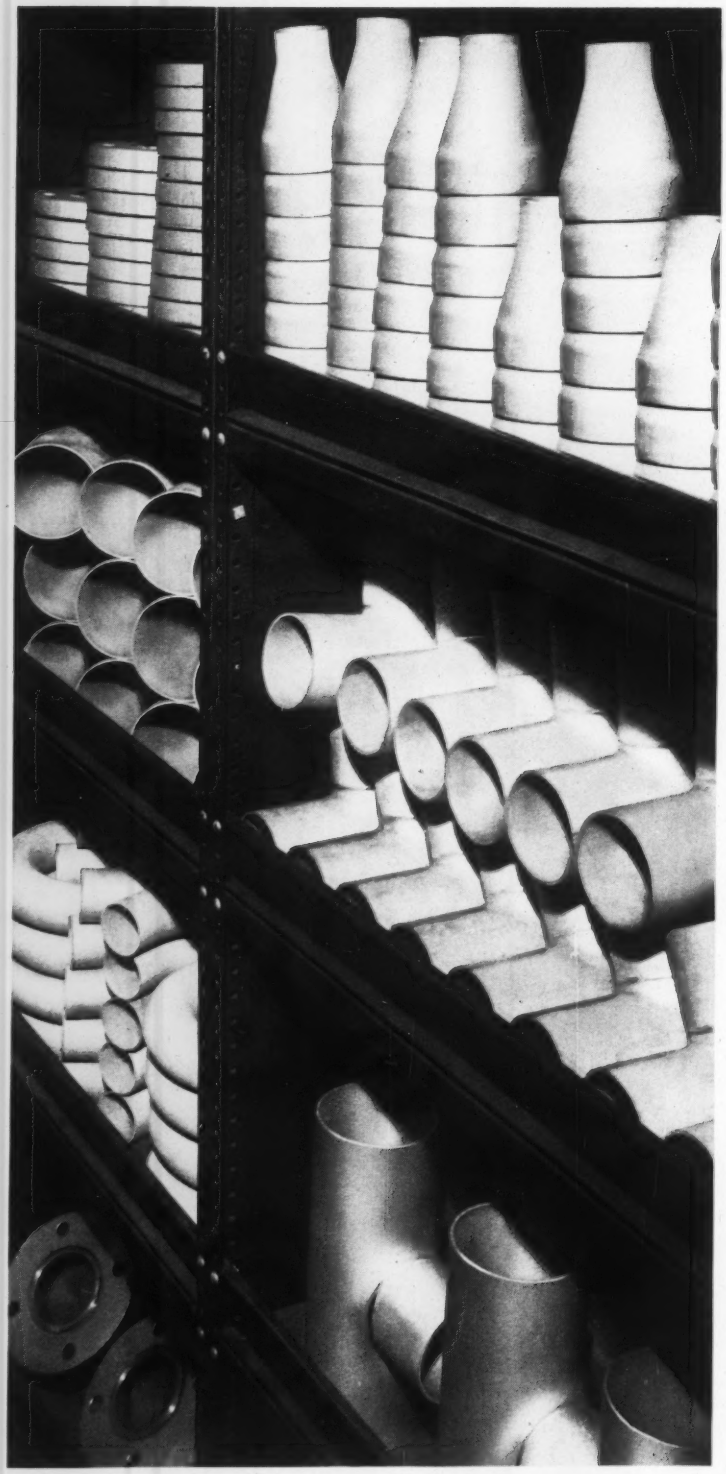
Speedline®

FITTINGS ARE IN STOCK NOW... COAST TO COAST

It's one thing to catalog a complete line of long-tangent fittings . . . it's another to have them ready to ship to your plant—*when* you need them. Speedline engineering and manufacturing experience has "standardized" production on even the most specialized fittings . . . including eccentric reducers, reducing tees and crosses . . . making it possible to maintain extensive inventories both at the factory *and* in the field.

A Speedline distributor is prepared to give delivery-from-stock on stainless steel fittings . . . including Carpenter 20 . . . for every process piping requirement. He can also assure prompt service on Speedline fittings in aluminum, titanium, zirconium, Hastelloy and other special corrosion-resistant alloys.

Leading plants have proved there *is* a measurable difference with Speedline fittings . . . the only complete line of long-tangent fittings available from distributor stocks. Let a Speedline distributor prove the difference Speedline experience and ready availability can make at your plant.



1003

Speedline®

CORROSION-RESISTANT FITTINGS

A PRODUCT OF **HORACE T. POTTS COMPANY** • 576 E. ERIE AVENUE, PHILADELPHIA 34, PA.

HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

DEMAND IS GREAT... EVERYONE IS BUYING THESE EXTRA VALUE PRODUCTS

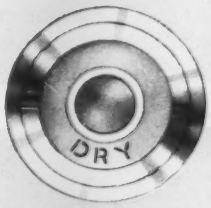
"DRI-VUE" Moisture-Liquid Indicators

"DRI-COR" Filter-Driers Molded Core

"GOLDEN BANTAM" Diaphragm Packless Valves

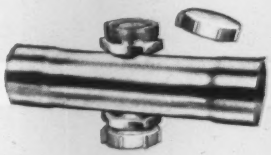
"DRI-VUE" INDICATOR PORT

Actually Spells "WET" or "DRY" with element Color Variation—Largest Visible Element Area.



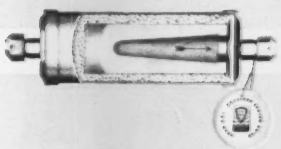
"DRI-VUE" INDICATORS

Double Port Moisture-Liquid Indicators, Large O.D.S. Sizes. Triple Sealed Ports.



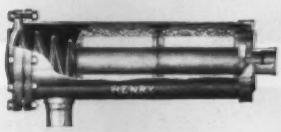
"DRI-COR" FILTER-DRIERS

Two Stage Drying; Molded Core and Granular Desiccant. Abso-dry Processed.



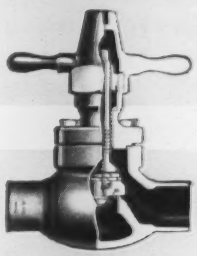
"DRI-COR" Cartridge DRIERS

Molded Filter Core and Granular Desiccant. Split Second Cartridge Installation.



SHUT-OFF VALVES

Packless and Packed with Flanged and Integral Connections. Wide Range of Sizes and Types.



Only Henry offers you this complete variety of types and sizes, from ¼" flare packless to 4⅛" O.D.S. packed Wing Cap valves, from 1 ton sealed type to 165 ton cartridge type filter-driers and ¼" flare single port to 2⅛" O.D.S. double port moisture indicators.

HENRY VALVE COMPANY

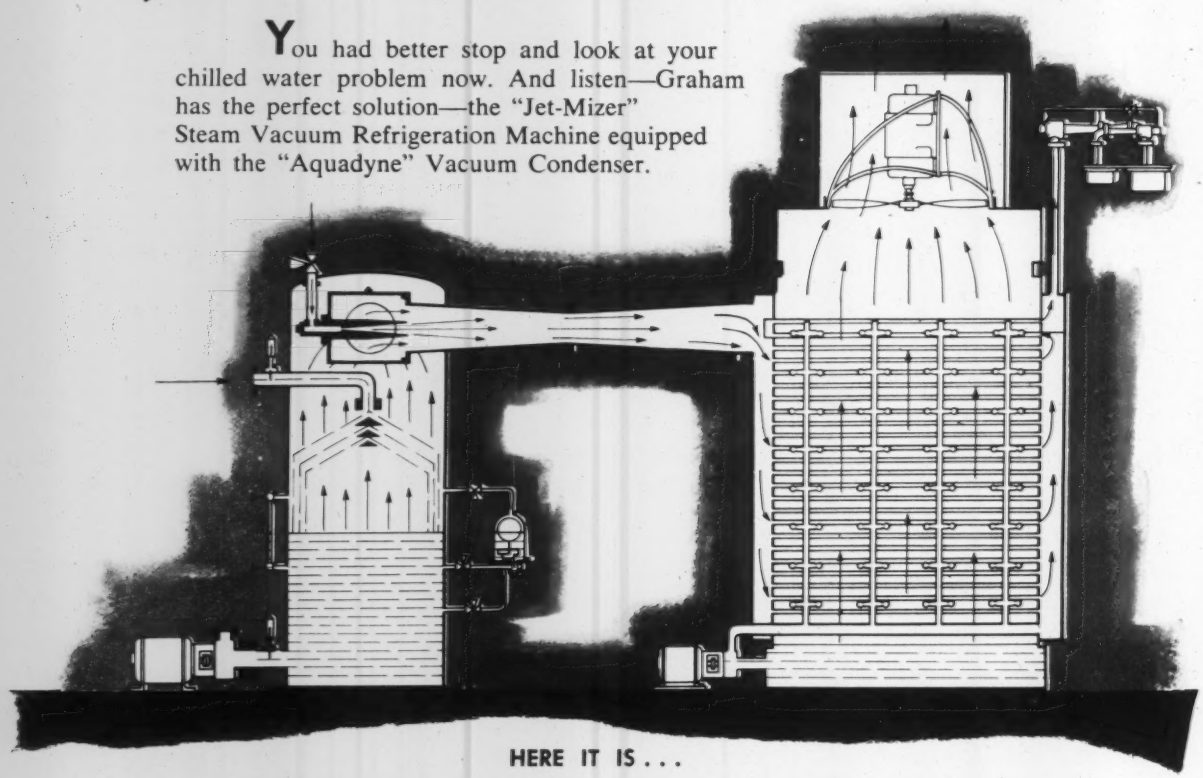
For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.

STOP... LOOK... ...and LISTEN!

Are you being held up for lack of cold water?

You had better stop and look at your chilled water problem now. And listen—Graham has the perfect solution—the "Jet-Mizer" Steam Vacuum Refrigeration Machine equipped with the "Aquadyne" Vacuum Condenser.



HERE IT IS . . .

. . . and here are a few of the things the "Jet-Mizer-Aquadyne" combination will do for you.

1. Provide any quantity of chilled water for your process requirements.
2. The Aquadyne Condenser requires no external source of cooling water whatsoever (provides its small amount of make-up water from its condensate).
3. A minimum of moving parts, hence a minimum of maintenance—completely automatic.
4. Extremely economical to operate and low in initial cost.

GRAHAM MANUFACTURING CO., INC.
Heliflow Corporation
170 GREAT NECK ROAD • GREAT NECK, NEW YORK
Offices in principal cities and Canada

Factory: Batavia, N. Y. Other Graham precision-built products: Steam Jet Ejectors, Heliflow Heat Exchangers, Monobolt Heat Exchangers, Deaerating Heaters, Surface and Barometric Condensers.

Propeller Fans
Ventilating Fans
Roof Ventilators
...a galaxy of products
to solve your air
handling problems...
Industrial Fans
Propeller Unit Heaters
Centrifugal Unit Heaters
General Purpose Fans
nyb
THE NEW YORK BLOWER COMPANY
Sales offices: 3149 South Shields Avenue • Chicago 16

This $5,000,000 fire might have been prevented with a **steel pipe** automatic sprinkler system

There wasn't much left when this $5,000,000 industrial property in New England burned to the ground. Yet how different the ending could have been if a *steel pipe* fire sprinkler system had been installed and the fire checked at its inception.

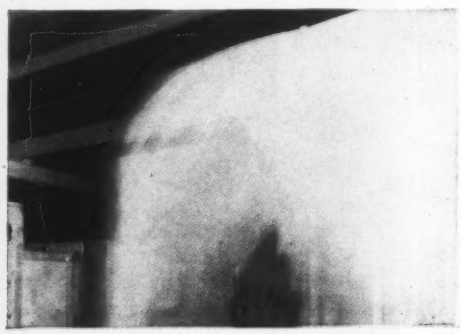
Yes, it pays to have an automatic sprinkler system in any building—store or warehouse, hospital or hotel, theater or school. As to cost—insurance premium savings often more than pay for the fire protection system's installation.

Backbone, of course, of fire sprinkler systems is dependable *steel pipe*. Architects, engineers and contractors know that low-cost, easily-worked *steel pipe* provides lasting and dependable service. That's why *steel pipe is first choice* for fire sprinkler systems, electrical conduit, vent and drainage lines, structural applications, radiant heating, snow melting, refrigeration, ice making and gas, air and water transmission lines.

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

INSIST ON PIPE MADE IN U. S. A.

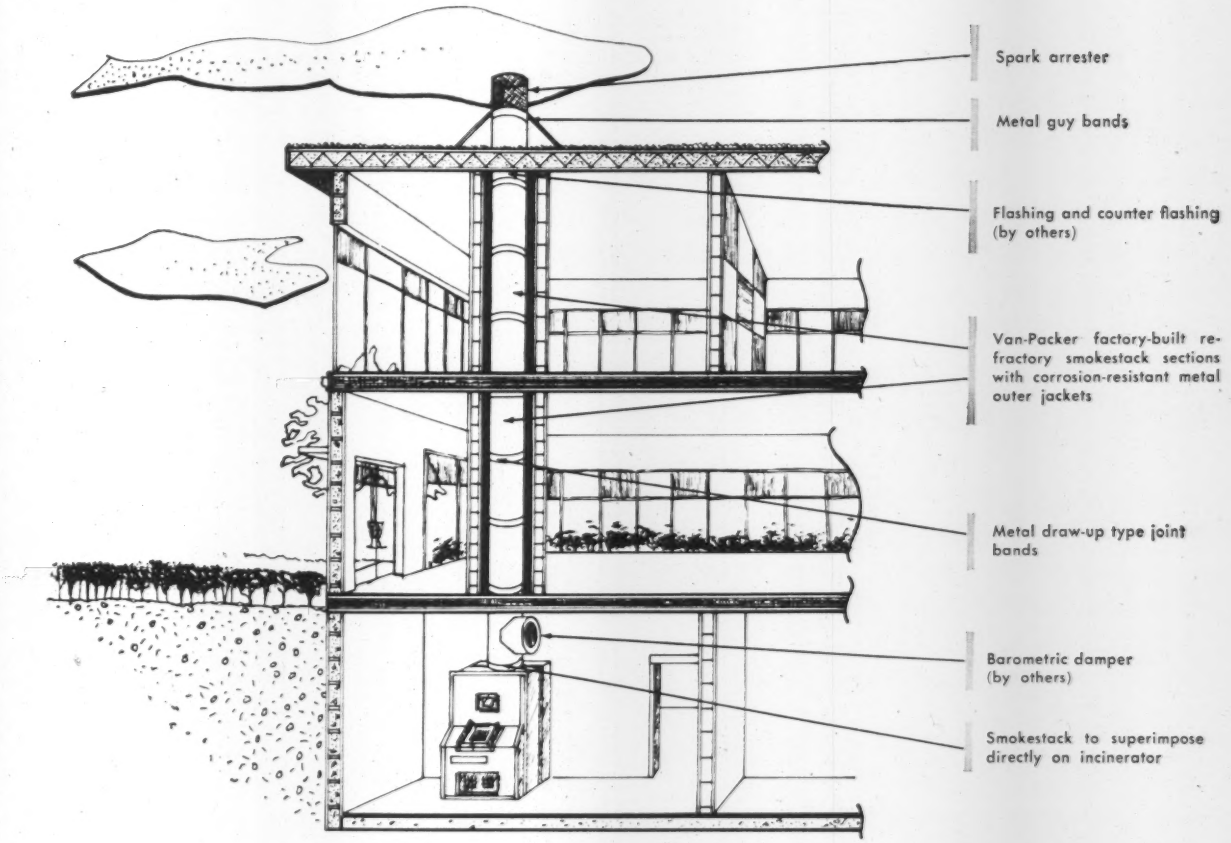


Automatic sprinkler systems check fires at their start—quickly, automatically and economically.

COMMITTEE ON
STEEL PIPE RESEARCH

150 East Forty-Second Street, New York 17, N.Y.

Flintkote • Van-Packer factory-built refractory smokestack is UL-listed for boilers and incinerators


Spark arrester
Metal guy bands
Flashing and counter flashing (by others)
Van-Packer factory-built refractory smokestack sections with corrosion-resistant metal outer jackets
Metal draw-up type joint bands
Barometric damper (by others)
Smokestack to superimpose directly on incinerator

The Van-Packer Model HT Smokestack is the *only* industrial smokestack listed under the Factory Inspection and Label Service Program of Underwriters' Laboratories, Inc. This factory-built, refractory stack outlasts steel stacks for comparable applications, yet costs no more. It can be superimposed on the boiler or incinerator, floor-supported on concrete or brick foundations, or supported with wall brackets. It provides high draft for efficient operation of the equipment and won't corrode, even under extreme acid conditions. A corrosion-resistant metal outer jacket eliminates maintenance and requires no painting. Available in 10″, 12″, 15″, 18″, 21″, 24″, 30″, and 36″ inner diameters. Mail coupon for full information, or see "Smoke Stacks" in your classified phone directory.

FLINTKOTE

VAN-PACKER®

Division of The Flintkote Company

Manufacturers of Diversified Products for Home and Industry

30 Rockefeller Plaza, New York 20, N. Y.
Phone: PLaza 7-5500

In the West:
Pioneer Division, The Flintkote Company
P. O. Box 2218, Terminal Annex, Los Angeles, Calif.

In Toronto, Ontario:
The Flintkote Company of Canada, Ltd.

The Flintkote Company
Van-Packer Division
30 Rockefeller Plaza
New York 20, New York

Please send Bulletin IS-40 containing complete information and engineering data on Van-Packer Smokestacks.

My name _____

Firm _____

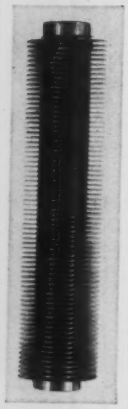
Address _____

City _____ Zone _____ State _____

NEW LOW SILHOUETTE FANDAIRE AIR-COOLED CONDENSERS

ALWAYS FACED RIGHT —NO MATTER WHAT THE WIND DIRECTION

No need to position circular Fandaire Air-Cooled Condensers to meet prevailing winds. Just set it anywhere for easiest piping.



Exclusive Aimco fintube design provides high-heat dissipating efficiency for circular Fandaire condensers.

Here's the newest, most advanced air-cooled condenser on the market—Fandaire! This modern low silhouette condenser is engineered around a new high-heat dissipating fintube of exclusive design and manufacture. In operation, the entire spiral of fintubing is surrounded with a circle of swiftly moving cool air for highest cooling efficiency. Every degree in temperature drop is fully utilized as this circular design captures the wind from *any* direction, regardless of placement or location. A powerful fan pulls cool air in and pushes warm used air up and away. Fandaire's constant gravity tube drainage gives continuous movement to condensate.

With its low, clean-lined silhouette, Fandaire does not detract from the general architectural effect of the building. And weighing ⅓ less than conventional installations, the Fandaire usually can be positioned where needed, without guy wires or extra bracing. Savings in piping and installation alone may be considerable.

Where there is a problem of architectural compatibility, or of cost or performance, chances are the new Fandaire Air-Cooled Condenser is the best solution. Engineered in sizes from 3 to 120 tons per unit, there is a Fandaire model for practically all single or multiple installations. Get complete information today.

YUBA

specialists in circular air-cooled condensers

YUBA-AIMCO DIVISION

801 West 21st Street, Tulsa, Oklahoma

YUBA CONSOLIDATED INDUSTRIES, INC.

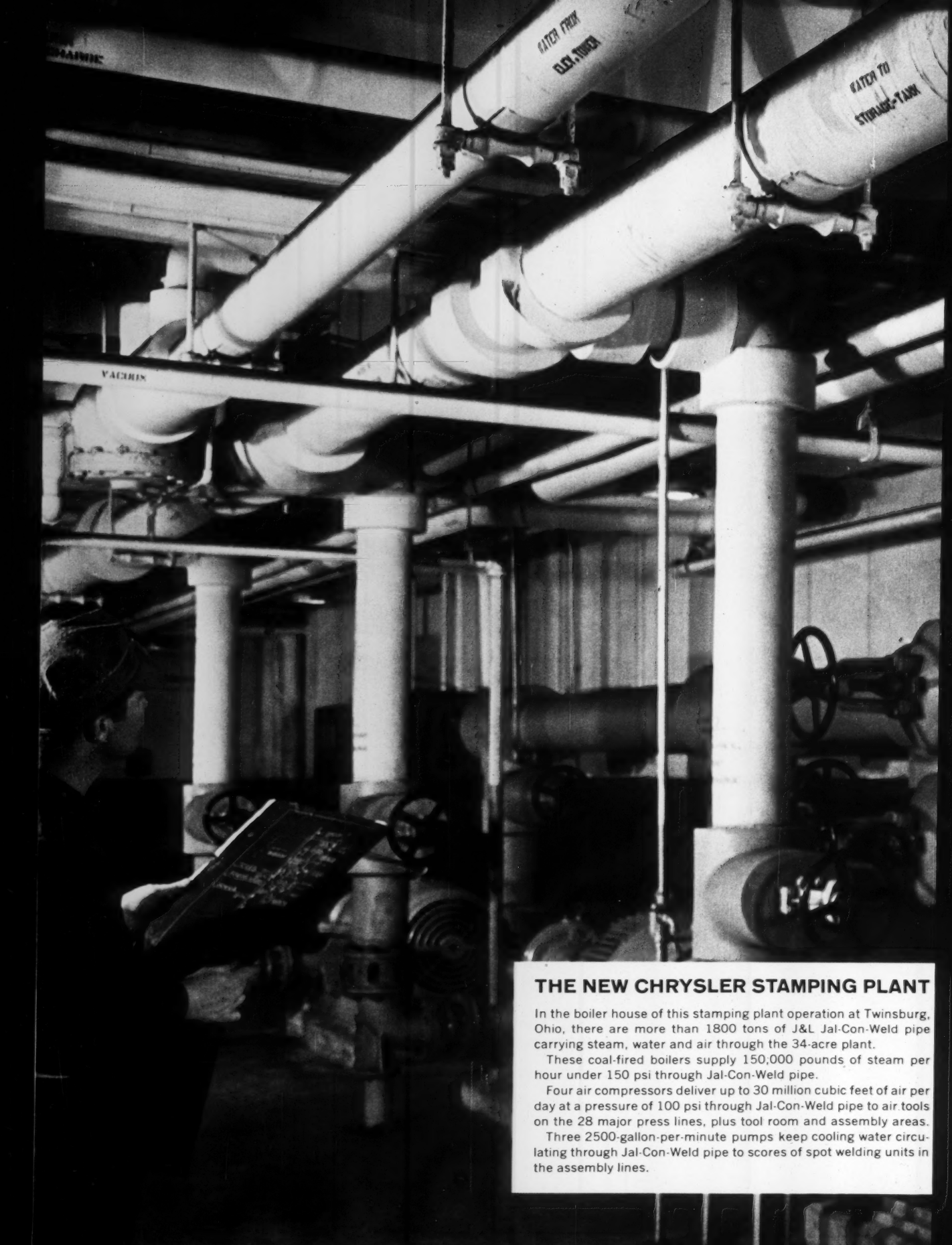
Sales Offices in Atlanta • Buffalo • Chicago • Cleveland • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Seattle

POWELL
giant in-stock valve supply for quick delivery

Powell maintains one of the largest in-stock supplies of bronze, iron, steel and corrosion resistant alloy valves in the world. So you can receive immediate valve delivery from Powell's factories or your nearby distributor's stocks and avoid costly operational delays or plant shutdowns.

For quick action, just pick up your phone and contact your local Powell Valve distributor or The Wm. Powell Company direct. With our 114 years of valve manufacturing experience, we can fill your valve needs and solve your valve problems! Let us hear from YOU—TODAY!

THE WM. POWELL COMPANY DEPENDABLE VALVES SINCE 1846 CINCINNATI 22, OHIO **world's largest family of valves**



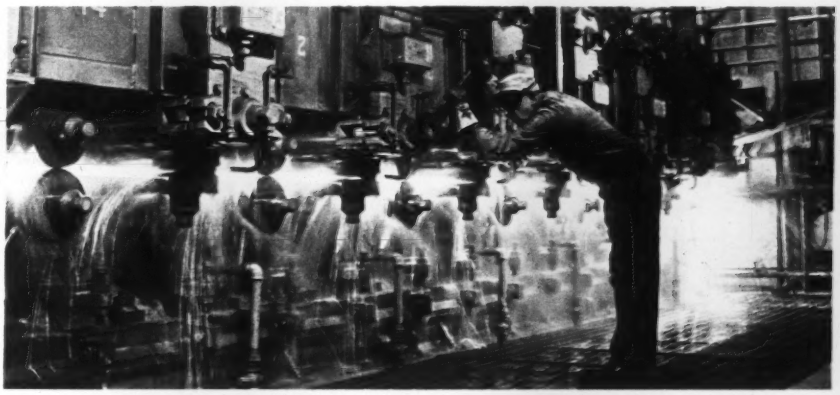
THE NEW CHRYSLER STAMPING PLANT

In the boiler house of this stamping plant operation at Twinsburg, Ohio, there are more than 1800 tons of J&L Jal-Con-Weld pipe carrying steam, water and air through the 34-acre plant.

These coal-fired boilers supply 150,000 pounds of steam per hour under 150 psi through Jal-Con-Weld pipe.

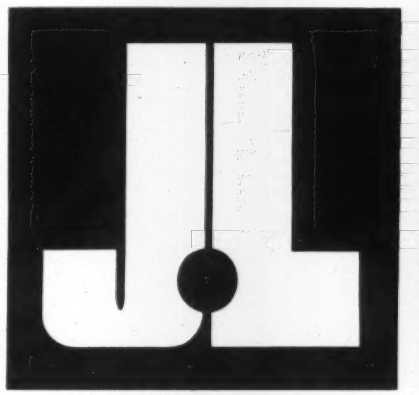
Four air compressors deliver up to 30 million cubic feet of air per day at a pressure of 100 psi through Jal-Con-Weld pipe to air tools on the 28 major press lines, plus tool room and assembly areas.

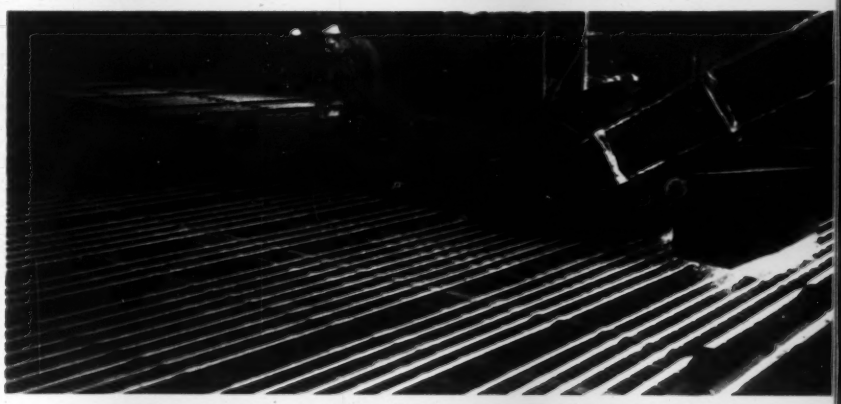
Three 2500-gallon-per-minute pumps keep cooling water circulating through Jal-Con-Weld pipe to scores of spot welding units in the assembly lines.



A continuous strip of skelp, heated to a welding temperature of approximately 2450°, passes rapidly through the forming rolls where it is shaped into cylindrical form.

In this mill, inspections include hydrostatic testing on each line in two modern Schloemann testers.





Finishing operations include cutting to proper length, straightening, facing, threading and hot dip galvanizing.

"Jal-Con-Weld pipe guarantees trouble-free installation and performance"

. . . says president of The Stanley-Carter Company

Over 1800 tons of Jal-Con-Weld pipe were installed by The Stanley-Carter Company in this new Chrysler stamping plant in Twinsburg, Ohio.

"J&L pipe is uniformly round, straight and easy to work," said Mr. Stanley Carter. "And, we like the service available through J&L and its distributors."

The distributor who handled this job was H. J. Rothwell Fitting Company, Canal Fulton, Ohio.

Jal-Con-Weld pipe is produced on two of the most modern continuous weld pipe mills in the world. These mills were installed by J&L at a cost of $18,000,000, and incorporate the most advanced equipment to produce high quality standard pipe in sizes which range from one-half inch to four inches.

The continuous weld process utilizes skelp in coil form. Weld is formed by pressure rolls, under ideal temperature conditions. Before skelp enters the welding pass, a jet of air is blown on the edge to remove scale and increase temperature for a stronger weld.

It will pay you to standardize on controlled-quality Jal-Con-Weld pipe.

Call your nearby J&L distributor, or for more information, write for J&L's new bulletin, "Jal-Con-Weld," Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

REMEMBER . . .

. . . the bite of the ice pick splitting a block of ice . . . the clank of tongs . . . the heave of the ice cake to the iceman's soaking shoulder apron? Remember his dripping trail up the walk, across the porch and kitchen to the icebox? What an appetite it had for cakes of ice . . . remember? And "mop up those tracks . . . don't forget to empty the drip pan!"

While the iceman made his rounds years ago, scientists worked to perfect a safe refrigerant. In 1931 development of "Freon" refrigerant opened the door to progress that has put safe, efficient, carefree refrigeration into nearly every home in the country. Today, "Freon" stands first for quality and leadership in serving the refrigeration and air conditioning industries.

Just as "Freon" is the refrigerant you know and trust, you can be sure Du Pont will continue research and development of its products and packaging. Always look for new developments from Du Pont. E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division, Wilmington 98, Delaware.

*Freon and combinations of Freon- or F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.

Capped in gold and factory-seated for purity

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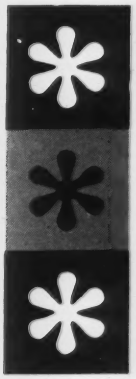


Stress Makeup Air Distribution, Control at Industrial Ventilation Conference

MAKEUP AIR must be properly distributed to obtain maximum utilization of it in the plant "living zone," according to K. E. Robinson, ventilation engineer, General Motors Corp. Speaking before the ninth annual industrial ventilation conference held recently at Michigan State University, Mr. Robinson emphasized the need for introducing makeup air at a low level in the plant. He suggested locating the supply outlets at a maximum of 10 ft above the floor. Some engineers, he said, specify installation of the supply outlets at lower heights — some as low as 7 ft — when the system is used also for summer relief ventilation. However, provision must be made to control the air pattern in winter to avoid worker discomfort. When makeup air is introduced at the 10 ft level in a plant with a 20 ft ceiling height, the theoretical air flow rate for 4 air changes will produce the equivalent of 8 air changes in the plant living zone, he said. Smoke tests have verified this observation. Introducing the makeup air at the 10 ft level also provides the cleanest air to the worker. The application of this and other principles in an existing plant were explained in the article, *Plant's Revamped Supply Air System Gives Workers Year 'Round Comfort* by Mr. Robinson in the January, 1960 issue of Heating, Piping & Air Conditioning.

Seminars, classroom design problems, and an open forum were combined at the conference to provide both new and experienced ventilation engineers with an abundance of useful information and practice in applying it. The success of the program to date is evidenced by the fact that 208 engineers participated in the course of study — almost twice the number in attendance nine years ago. The conference is sponsored jointly by the Michigan department of health and Michigan State University's mechanical engineering department. Topics covered in the general sessions included makeup air distribution and control, exhaust system components, recovery of heat from exhaust air, and case histories of applications from an industrial ventilation engineer.

Control of makeup air systems beginning with the simplest of systems comprised of a heating device, intake, and fan, and progressing to the more complex systems was discussed by L. E. Burch, of R. L. Deppman Co. Some of the points he emphasized were:

1) On small makeup air units — 3 to 5 hp and smaller fan motors — the intake damper can be opened when the fan is started. On larger sizes, however, where provision for recirculation is not made, the damper should be opened first to prevent damage to the intake damper and the casing of the unit. An auxiliary switch mounted on the damper can be used to start the fan when the damper is wide open.

2) Recirculation dampers mechanically linked with the intake are good insurance against freeze up. They also prevent damage to the intake dampers on start up and permit use of the makeup air heater for heating only when the plant is shutdown over weekends.

3) Don't depend on steam pressure in high pressure systems to cause condensate to drain through overhead condensate lines. This is a common piping arrangement but should be avoided because it makes the system vulnerable to freeze up. The condensate must flow freely from the heating coil to minimize the possibility of freezing.

4) Steam distributing tube coils

with supply and return connections on the same end produce more stratification than those with the supply and return connections on opposite ends of the coil. Thus, less difficulty is experienced in controlling the latter type.

In discussing the use of electronic controls in makeup air systems, Mr. Burch presented information contained in an article by C. J. Busch in the August 1959 issue of Heating, Piping & Air Conditioning.

Discuss Hoods, Fans

Scale models of various types of exhaust hoods were used by James Barrett, Michigan department of health ventilation engineer, to demonstrate that hoods must be close to the contaminant source to function properly. A baffle or flange at the hood inlet to prevent flow along the duct and into the inlet was shown to improve hood performance and decrease the pressure loss at the inlet. For best results, according to Mr. Barrett, the exhaust should be taken from in front of the worker, with supply air coming in from behind him to carry the contaminant away from his breathing zone. Good exhaust hood design in addition to providing greater protection for the worker requires a smaller quantity of exhaust air with resultant savings in equipment and operating costs, he said.

W. E. Tracy, application engineer, Sturdevant Div., Westinghouse Electric Corp., discussed fan performance with particular reference to the effects of inlet and outlet connection design. A movie on this subject, produced through the joint efforts of the Michigan department of health, Westinghouse, and MSU was premiered at the conference. The film is now available from the health department. Mr. Tracy noted that poor fan performance is often due to improperly designed fan connections. He suggested the following rules:

1) For low outlet loss with fans discharging freely to the atmosphere, add a duct two diameters long on the fan outlet. The lowest outlet loss is obtained with an evase (tapered) outlet.

2) For low inlet loss, the inlet must be designed to provide uniform flow into the fan. Where an elbow must be used, long radius turns or turning vanes should be provided for this purpose.

3) When the fan inlet is situated near a wall, keep the inlet at least one half the wheel diameter from the wall for low inlet loss.

In another general session, J. G. Rutherford, International Nickel Co., described several unique systems used by his company to recover heat from return air exhausted from underground mining operations. Incoming supply air is preheated in the recovery systems, thereby effecting considerable savings of fuel in an area where winter temperatures average 15 F and go as low as —30 F. Details of some of these systems can be found in the article by Mr. Rutherford in the May 1959 issue of Heating, Piping & Air Conditioning.

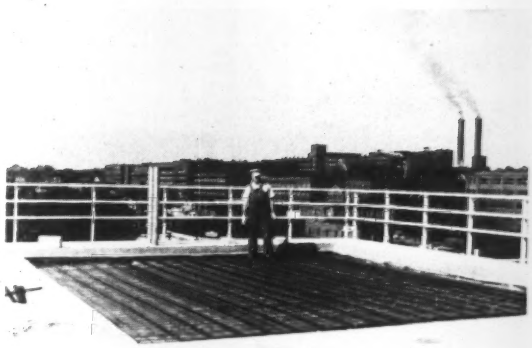
Gives Case Histories

Dr. A. D. Brandt, chief industrial hygiene engineer, Bethlehem Steel Co., presented several case histories of unusual systems in discussing practical applications of industrial ventilation. In an engine room in which 12 engines were fueled at the rate of 4450 cfm with blast furnace gas containing 27 percent CO, the CO concentration on the operating floor ranged from 1 to 3 times the threshold limit and from 5 to 7 times that limit in a travelling crane cab above the floor. Natural ventilation through gravity roof vents was estimated at about 410,000 cfm, which suggested that additional mechanical ventilation by means of exhaust fans would provide little improvement. The problem was solved by supplying ventilation air through floor grilles and utilization of the basement as a plenum. Acceptable concentrations were obtained in the center of the floor as well as at the perimeter by this means. The crane cab was ventilated through its own system with the supply duct to the crane connected by means of a "zipper joint" to the main supply plenum. Rubber belting provided the seal between the travelling takeoff for the cab and the supply plenum. Only slight leakage between the takeoff and belting results when the supply pressure is maintained at 0.4 in. water gage.

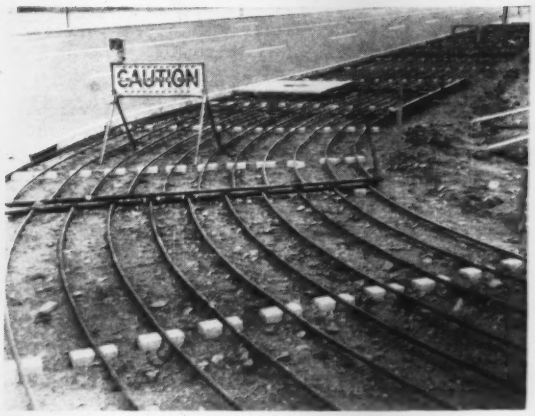
In another case involving the application of lead coating to wire and rod, lead scale from the operation was of more significance than lead fumes from the hot tanks, he said. These tanks were located in a corner room that as a result of expansion became an interior room. Adequate ventilation was obtained through 9 ft x 63 ft. hoods which extended directly to the roof, until windows were closed — then trouble arose due to the lack of adequate makeup air. In this case, makeup air was brought in from the roof by enclosing the exhaust hood in a makeup air duct. The makeup air entering from roof vents drops to the opening of the hood and is discharged outdoors, thus eliminating the need for heating it.

In closing, Dr. Brandt suggested that best performance will be obtained from the industrial ventilation system that is made as simple as possible and one that requires a minimum amount of attention by the operator.

Dr. A. E. Heutis, commissioner, Michigan department of health, delivered the opening address to the conference. He noted that sound principles of industrial ventilation must be applied to meet increasing community air pollution problems.



SNOW-MELTING pad installed on parking roof



PIPING GRID frees sidewalks of ice and snow

Snow Melting Systems Reduce Driving, Walking Hazards

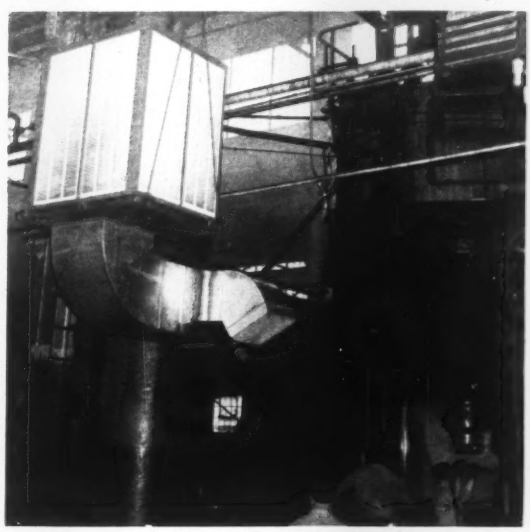
Two 28 by 20 ft concrete pads atop the new Akron, O., *Beacon Journal* parking garage have been inlaid with a pipe grid encased in a $3\frac{1}{4}$ in. concrete slab over the structural foundation. Snow from the parking area is piled on the slabs, where it melts and drains to the city sewers. An additional 8500 ft of pipe was used to insure snow-free conditions for the garage's side-walks and ramps.

In New Haven, Conn., three sidewalks with an area of 9100 sq ft. surrounding the new general offices of the Southern New England Telephone Co., have been equipped with $\frac{3}{4}$ in. snow melting grids placed on 12 in. centers. The piping system is enclosed in a 5 in. concrete slab.

Wrought iron pipe has been used to carry the hot water-ethylene glycol heat transfer medium in both systems, according to A. M. Byers Co.

Forbes-Stanford Co. was the piping contractor for the Akron installation. C. N. Meriden Co. installed the New Haven system.

Evaporative Cooler Cures Low-Level Forge Heat Problem



ALUMINUM CO. pressmen get conditioned air at point-of-work from overhead cooler in Ohio plant

A DESERT TYPE evaporative cooler, installed close to a large press with an adjacent preheating furnace in an Aluminum Co. of America Ohio plant, shown at left, has been found to provide comfortable working conditions for the four workers in the area.

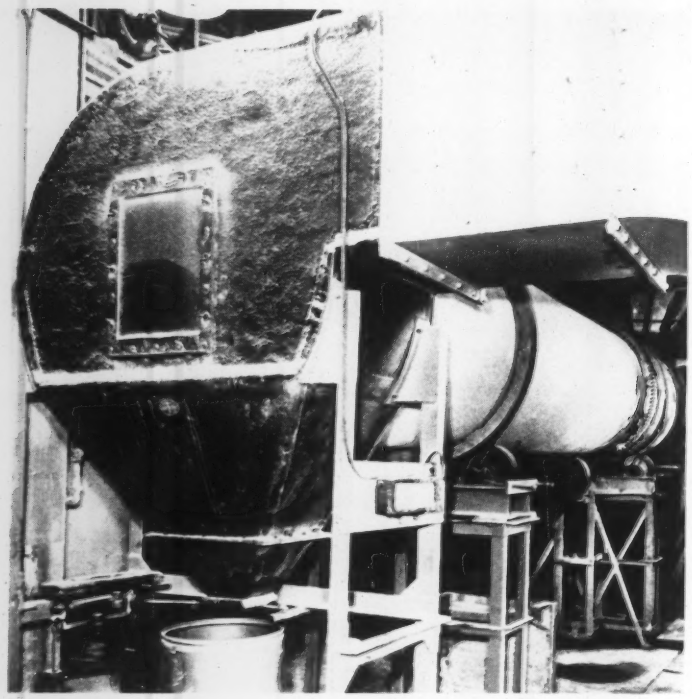
The installation was made at the suggestion of the plant engineer, when it was realized that the lack of low-level air supply at the press could not be rectified in the usual manner because overhead crane rails and other obstructions prevented the proper delivery of outdoor air through a roof intake and downcomer installation.

The evaporative cooler delivers recirculated room air through four grilles at 4000 cfm, 9 ft above the floor level. The installed cost, including 16 ft of prefabricated ductwork, totalled $1500.

Plastic Dryer Solves Corrosion Problem

INSTALLATION of a glass fiber-reinforced, polyester rotary dryer has solved a difficult acid corrosion problem in an Eastern chemical plant. The dryer is used to process several inorganic materials normally wet with hydrochloric acid, and consists of a large revolving drum into which drying air is introduced at 225 F, according to the Durez Plastics Div., Hooker Chemical Corp.

The plastic material was pretested for several months in a 1 ft section of the equipment, after which the complete dryer was fabricated. Six months' service of the dryer has produced no sign of corrosion. Interior surfaces of the drum have been eroded only slightly by materials being dried, according to du Verre, Inc.



Air Piping System Prevents Ice Damage

FACED WITH the problem of costly annual repairs to piers and floats necessitated by surface ice formations up to 1 ft thick, the Charles River Yacht Club in Cambridge, Mass., found a solution in the installation of a 1500 ft piping system to furnish compressed air to the water side of the basin.

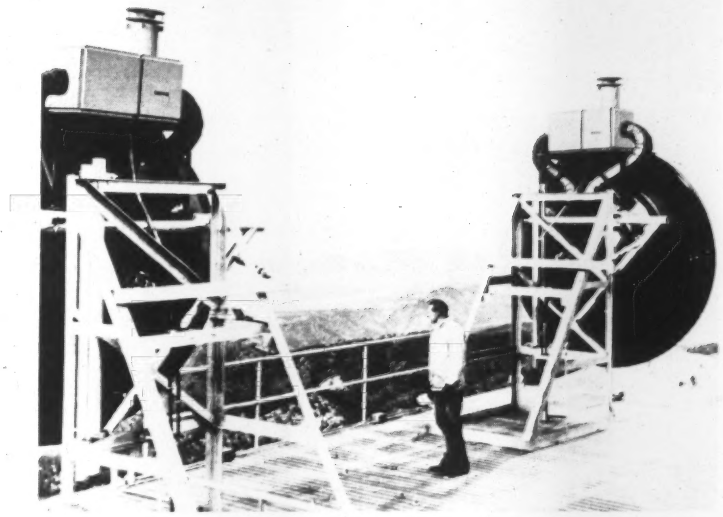
Pin-point holes throughout the length of the pipe line allow the compressed air to stir the warmer water from the river bottom to the surface, producing an approximate 15 ft expanse of clear water around the piers.

Two continuously-operating air compressors supply the needed air to the system, according to Brunner Div., Dunham-Bush, Inc.

ASA Asks Industrial Gas Installation Standards

THE American Standards Association, a federation of national trade groups, professional societies, and consumer interests, voted at a recent general conference in New York to recommend the establishment of a project to obtain basic standards for the installation, safe operation, testing, maintenance, and nomenclature of industrial gas utilization equipment and associated in-plant gas-air proportioning and mixing equipment, together with gas piping supply systems not covered by the Code for Pressure Piping.

The conference suggested that the project be sponsored by the American Gas Association, sponsor of a similar project for domestic gas equipment. The probable base for the work will be a proposed Standard drawn up by the AGA Industrial Gas Practices Committee, with jurisdiction maintained by the ASA Miscellaneous Standards Board.



Automatic Unit Heaters Defrost Giant Cross-Country Relay Antennas

SPECIALLY designed liquid-propane direct fired unit heaters have been installed atop each of the 10 ft parabolic micro-wave relay antennas used by the Bell Telephone Co. of Nevada for cross country communication relay.

The antennas, spaced 50 miles apart across the Nevada mountain range, were subject to severe icing which would reduce their effective range of transmission. The nearest manned control stations are 30 miles from any of the antenna sites.

An individual unit heater mounted on top of each antenna blows air heated to 130 F across the grid, preventing snow accumulation and ice formation. The heaters are fitted with "snorkels" which provide combustion air to the burners at the proper velocity even in winds up to 70 mph.

The 60,000 Btu per hr heaters operate automatically when temperatures range between 20 and 38 F. Liquefied propane gas reservoirs are located at each antenna site, according to Reznor Mfg. Co.

Consulting Engineers Name New President

RICHARD H. TATLOW III, president of Abbott, Merkt & Co. of New York, has been elected president of the American Institute of Consulting Engineers, to succeed George S. Richardson of Pittsburgh.

Mr. Tatlow is a graduate of the University of Colorado. During World War II he served as a member of the War Department Construction Advisory Board, during which time he held the rank of colonel.

Boiler Groups Effect Merger

THE American Boiler Manufacturers Association and Affiliated Industries has merged operations with the American Boiler and Affiliated Industries Standards Committee.

The new group will be known as the American Boiler Manufacturers Association, and will maintain an office at 1180 Raymond Blvd., Raymond Commerce Building, Newark 2, N.J., to replace the seperate offices formerly operated by each group.

U.S.S.R. To Raise Plastics Production

THE U.S.S.R. plans to increase its plastics production facilities eightfold by 1965, according to F. C. Sutro Jr., president of the Society of Plastics Engineers.

A goal of a 400 million lb annual polyethylene production has been set, although facilities for making this type of plastic are nonexistent in Russia today. Other plastic materials which will be emphasized include PVC, acetate, and polystyrene.

Mr. Sutro notes that the Soviet facility for producing industrial plastic materials—the thermosetting plastics used for electrical components—have been well established for some years, and that the U.S.S.R. research in all phases of the industry is impressive.

Russia produced 536 million lb of plastic material in 1957 (the last year for which figures are available) while the U.S.A. produced 5.6 billion lb in 1959.

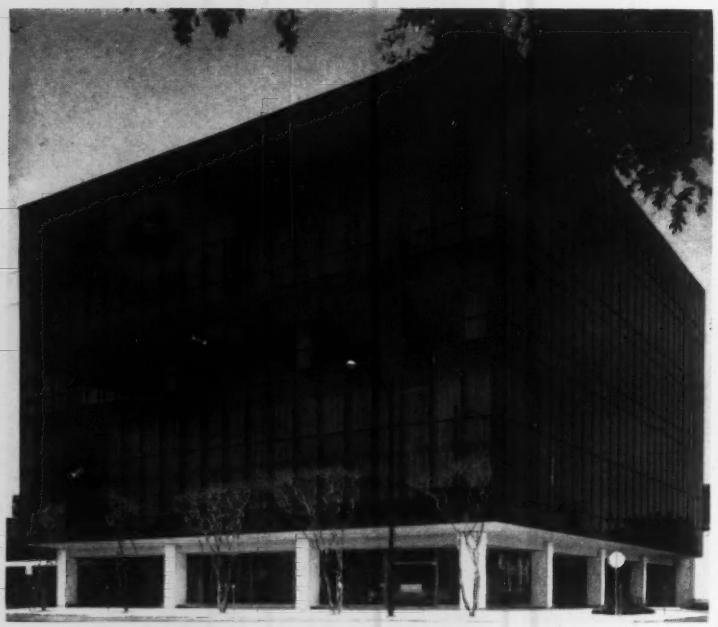
Mr. Sutro's remarks were made in conjunction with the recent 16th Annual Technical Conference of the Society.

UN Atomic Radiation Group Ends Seventh Session

THE United Nations Scientific Committee on the Effects of Atomic Radiation concluded its seventh session at UN headquarters in New York City recently.

Among the principle items discussed at the meeting were the physical and meteorological aspects of atomic fallout, including the occurance, distribution, and transportation of radioactive particles in the earth's atmosphere. Experts numbering twelve from eight countries were heard on the subject of high altitude radioactive debris transport.

The eighth general session will be held in Geneva, Switzerland on September 19 to 30, 1960.



Gas Absorption System Air Conditions New Bank

THE NEW Gibralter Savings and Loan Association headquarters in Houston, Tex., employs a 332-ton gas absorption type water chiller to provide conditioned air to its five stories. All major mechanical equipment for the system is located atop the structure in a central penthouse, freeing the basement area for parking facilities. The partially open first floor includes a drive-in banking area and glass-enclosed lobby.

A peripheral duct system on each floor delivers a curtain of conditioned air over the inside of the building's solar glass walls. Air handling units serve the ground floor lobby area, each of the four zones of the main banking floor on the second level, and two zones each on the third, fourth, and fifth floors. Two 160 hp boilers operating at a working pressure of 12 psi supply steam to the chiller and water heater.

Piping in the floor of the second-story banking area permits additional radiant heating during winter months to compensate for under-floor exposure on the first level. A master control board located in the penthouse permits centralized temperature measurement of each of the building's zones. Temperatures of the heated and chilled water systems can also be read from the board.

Future plans call for the addition of five stories to the building. When the addition is completed, the present penthouse will be entirely surrounded by office spaces. The equipment within the penthouse is so arranged that it can accommodate the additional needs for the expansion. The system of zoning by floors will be repeated when the building is enlarged, according to United Gas Corp.

Bernard Johnson and Associates were the consulting engineers who designed the system. Wood-Leppard Air Conditioning Co. was the mechanical contractor for the building.

C.E.C. To Install New Officers

AN OFFICIAL BALLOT of the Consulting Engineers Council Board of Directors in February resulted in the election of Hueston M. Smith as CEC's next president. Mr. Smith is a partner in Smith-Hanlon-Zurheide-Levy, Inc., St. Louis consulting firm.

Other officers elected, and the regional councils with which they are associated are: Harold P. King, California, 1st vice president; Fred K. Steel, Montana, 2nd vice president; George J. Toman, North Dakota, secretary; and Lester L. Bosch, Cincinnati, treasurer.

Installation of the new officers is scheduled for the May 5, 1960 CEC fourth annual meeting to be held at Gearheart, Oregon. Terms are for the 1960-61 period.

Underwriters Lab. Sets High-Efficiency Air Filter Standard

UNDERWRITERS' LABORATORIES, INC., has announced the completion of the first standard for high efficiency air filters, UL 586, intended for use in exhaust ducts in ventilating systems where radioactive materials are handled or processed.

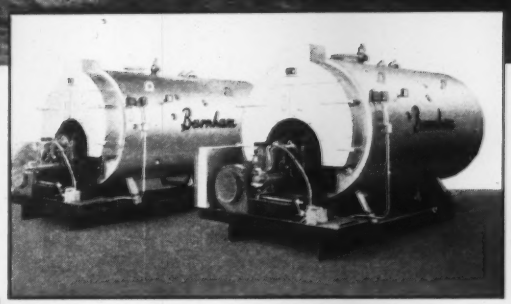
The air filter devices covered in the new standard are required to be 99.95 percent efficient for 0.3 micron and larger particles. Because of the radiation hazard connected with the contaminants to be filtered, the Atomic Energy Commission requires that the standard provide for individual inspection of every filter unit granted a UL label, including flame tests of the filter frame, gasket material, and medium.

The program for examination, test, and listing of these devices is now in operation. Procedures toward the granting of certification labels are undertaken upon request by individual manufacturers.

THE BIG ONES COME TO BURNHAM

TEMPLE OHEB SHALOM — BALTIMORE, MD.

LEAVITT ASSOCIATES	*Architects, Norfolk, Va.*
THE ARCHITECTS COLLABORATIVE	*Consulting Architects, Cambridge, Mass.*
SILVER AND ASSOCIATES	*Consulting Engineers, Washington, D. C.*
CONSOLIDATED ENGINEERING CO., INC.	*General Contractors, Baltimore, Md.*
THE OREOLE REFRIGERATION CO.	*Mechanical Contractors, Baltimore, Md.*



MAGNIFICENT NEW TEMPLE TO HEAT WITH BURNHAM SCOTCH-TYPE BOILERS

Designed with the active collaboration of the world-famous architect, Dr. Walter Gropius, the Oheb Shalom Temple is outstanding in every way.

As in many other structures where quality is demanded, Burnham heating was chosen. Two Burnham Packaged Scotch-Type Boilers with complete oil-fired forced-draft combustion units were selected. Each has a certified water rating of 2,625 MBh.

Stock sizes in these Packaged Scotch-Type Boilers range in capacity from 2,930 to 39,370 sq. ft. net E.D.R. steam, new SBI ratings or net steam or water 702 MBh to 9,450 MBh. They give you an important advantage . . . a perfectly matched combination of boiler and burner for heavy oil, light oil, or oil/gas combination. Standard models with up to 4,000 sq. ft. of heating surface can also be supplied when specified.

Also available for prompt shipment: Compact Type Table 1 and Table 2 steel boilers

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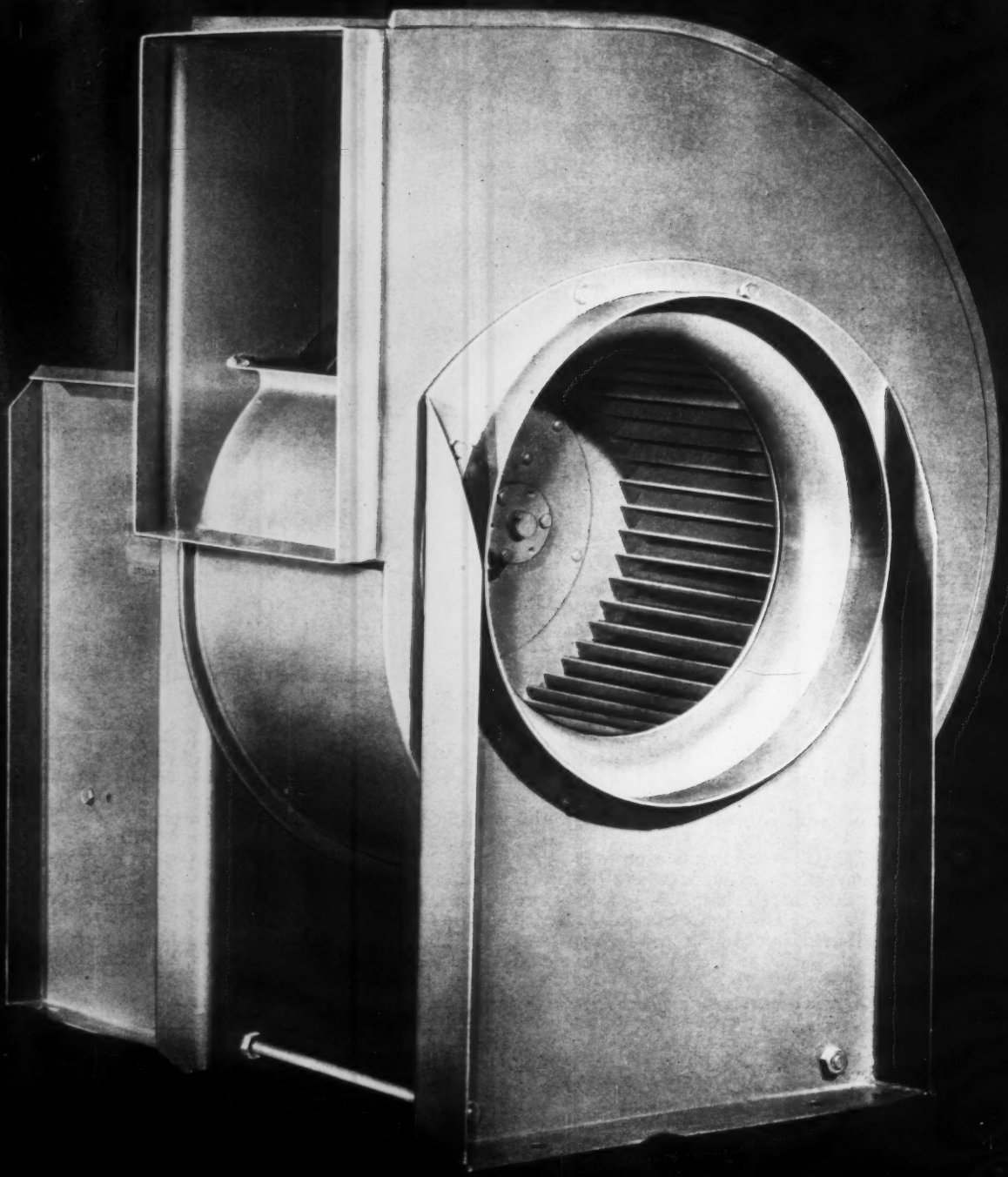

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★ ***New motor mountings for increased quietness***

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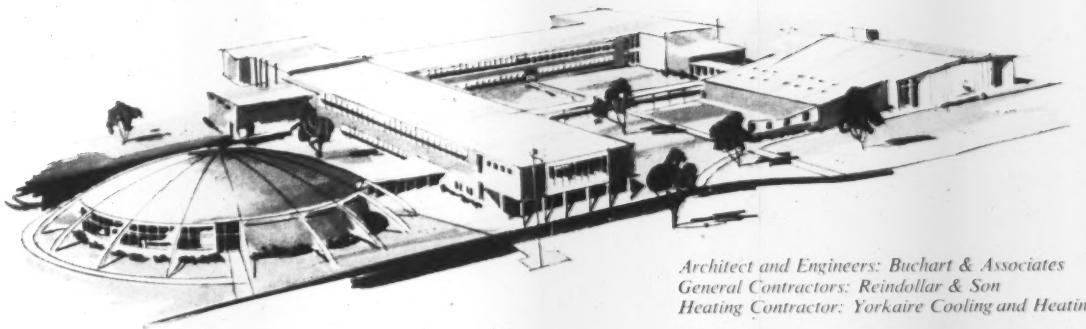
For further information, write for Bulletin 3401.

Mr. Curtis A. Botts—heating and ventilating contractor for the new Hannah Penn Junior High School, York, Pa., says:

"Working with Honeywell, and finished

Mr. Curtis A. Botts, President of the Yorkaire Cooling and Heating Company, in one of the Honeywell-controlled classrooms at Hannah Penn Junior High School. For excellency of design, this beautiful new school was awarded a certificate of merit by the American Society of Registered Architects.

we started the job on time."



Architect and Engineers: Buchart & Associates
General Contractors: Reindollar & Son
Heating Contractor: Yorkaire Cooling and Heating Co.

Trained Honeywell specialists helped keep Hannah Penn school on schedule, supervising the temperature control system during planning, installation and checkout.

"Honeywell's trained specialists helped us avoid costly delays," says Mr. Botts. "They turned in clear shop drawings of the temperature control system. They helped speed up equipment deliveries. They gave us good supervision during installation, then checked out the entire system. As a result, we started on time, and *stayed* on time until the job was finished."

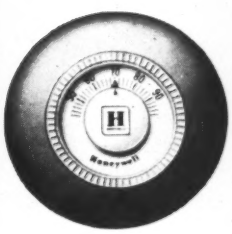
The result for this handsome new school is an efficient, smooth-working temperature control system with wall-mounted classroom thermostats—a system that assures an indoor climate ideal for better teaching, better learning.

If your next job calls for a temperature control system by Honeywell, you'll get all the help you need from skilled, efficient specialists—help that saves you money, time and worry. Get the whole story; call one of the 112 Honeywell sales and service offices nearest you. Or write Honeywell, Dept. AC-4-75, Minneapolis 8, Minn.

Honeywell

First in Control

SINCE 1885



The Honeywell Round Thermostat—famous symbol of quality temperature control

PIONEERING THE FUTURE

DETROIT'S NEW COBO HALL EXHIBIT BUILDING

equipped with enduring, non-rusting

REVERE COPPER WATER TUBE

39,140 feet of it!

Now nearing completion on the banks of the Detroit River is the magnificent, new $45,000,000 magnet for attracting large conventions and sporting events to the motor city . . . COBO HALL-CONVENTION ARENA.

In a civic structure such as this 2 key requisites are: the lasting qualities of the materials used in construction and low maintenance once the building has been completed.

Through the centuries copper has proved itself to have both of those requisites.

Here's what Mr. Edward A. Page, President of Page Plumbing & Heating Company, has to say about copper water tube . . . "The more important the job the more important it is that copper water tube be used. For, in addition to being easier to work with and its ready adaptability to prefabrication, in the shop and on the job, you never have to worry about its lasting qualities or having to make a lot of costly callbacks. Believe me, the performance of the lines installed by the plumbing contractor is a mighty important item . . . it can make or break his reputation.

"Over the years we've guarded our reputation most carefully by the wide use of copper water tube and by paying careful attention to how it is installed. We've found it pays. To us, building for keeps means copper of course."

Engineers, contractors, home builders and architects have also found that copper water tube is equally important for use in drainage, waste and vent lines, air conditioning lines, radiant panel heating, underground service lines, oil burner and processing lines. It's also important that you specify a particular brand of copper tube . . . Revere, the oldest name in copper.

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Founded by Paul Revere in 1801

Executive Offices: 230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

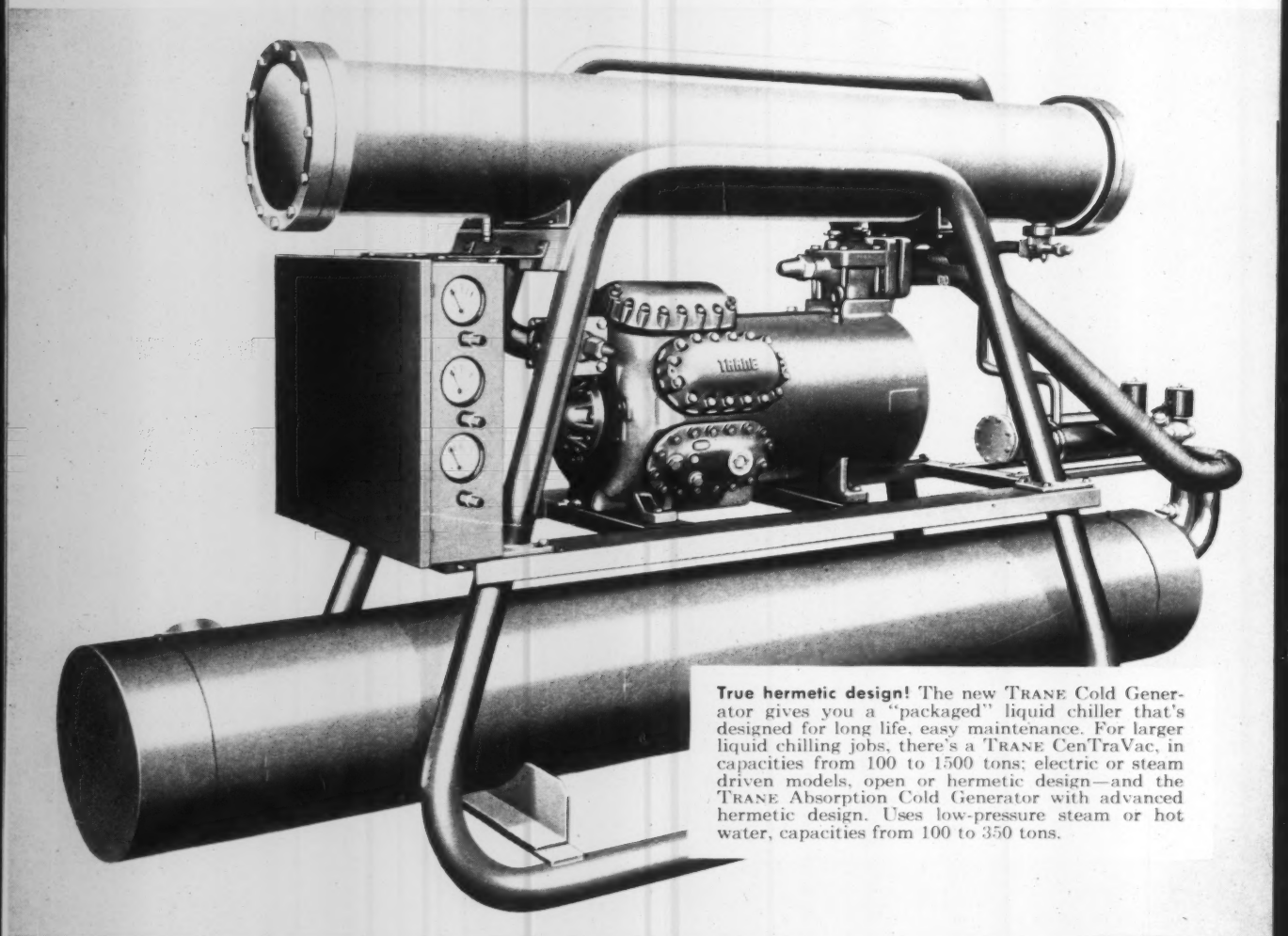
"Building for keeps means COPPER of course."

says MR. EDWARD A. PAGE, *President*
PAGE PLUMBING & HEATING COMPANY
River Rouge, Mich. Subcontractor for
Cobo Hall—Convention Arena.

• • • •

GIFFELS & ROSSETTI-Architects & Engineers, Detroit
O. W. BURKE COMPANY-General Contractor, Detroit
THE STANLEY-CARTER COMPANY-Prime Mechanical Contractor
Cobo Hall, Detroit
Revere Copper Water Tube Distributors:
NELSON COMPANY . . . DETROIT NIPPLE WORKS, both of Detroit

Cut liquid chilling costs- with this new Trane



True hermetic design! The new TRANE Cold Generator gives you a "packaged" liquid chiller that's designed for long life, easy maintenance. For larger liquid chilling jobs, there's a TRANE CenTraVac, in capacities from 100 to 1500 tons; electric or steam driven models, open or hermetic design—and the TRANE Absorption Cold Generator with advanced hermetic design. Uses low-pressure steam or hot water, capacities from 100 to 350 tons.

Now! A hermetic model of the Trane Reciprocating Compressor!

Here's a new, efficient Reciprocating Compressor that's *fully hermetic*, designed for the more rigorous demands of R-22. This unit is of single-housing construction. Motor and compressor are in one shell, with a bolted end cover for easy access. This minimizes alignment problems experienced with other hermetic compressors that have 2-part housing.

The new TRANE Hermetic Reciprocating Compressor has multi-step capacity control that saves power by reducing starting, stopping. And the truly hermetic design eliminates crankshaft seal and coupling to provide quiet operation, simplified installation, longer life.

Check these features:

- **Designed for R-22 and R-12** (not a converted R-12 machine).
- **Single-housing construction** for simplified installation, trouble-free operation, easy access for maintenance.
- **Multi-step capacity control** reduces starting, stopping, saves power.
- **Exclusive internal thermal protector,** located in the motor windings, protects against any condition that causes high motor temperatures.
- **Large suction chamber** and cylinder head safety springs provide protection against refrigerant slugging.
- **Available** in sizes from 10 to 100 tons.

for comfort or process-
Hermetic Cold Generator

Advanced hermetic design assures long, trouble-free life, quiet operation. Cuts installation costs.

Here's low-cost, efficient liquid cooling for process or comfort—from TRANE, long an industry leader in reciprocating water chillers. It's the new TRANE Reciprocating Cold Generator, now *hermetic*, with TRANE chiller and condenser—plus a new TRANE Hermetic Compressor (illustrated and described below).

A major step forward in industrial liquid cooling equipment, this new Hermetic Cold Generator features lightweight, compact design that simplifies installation and maintenance. It is completely factory-wired and assembled, with prewired control panel mounted directly on the unit to eliminate much on-the-job installation labor. Designed for R-22 and R-12, it is available in a complete range of 11 sizes from 10 to 100 tons.

When you plan industrial liquid chilling equipment—for processing or air conditioning—contact your nearby TRANE Sales Office for facts on the complete line of TRANE water chillers from 10 to 1500 tons; or write TRANE, La Crosse, Wisconsin.

Check these advanced TRANE features:

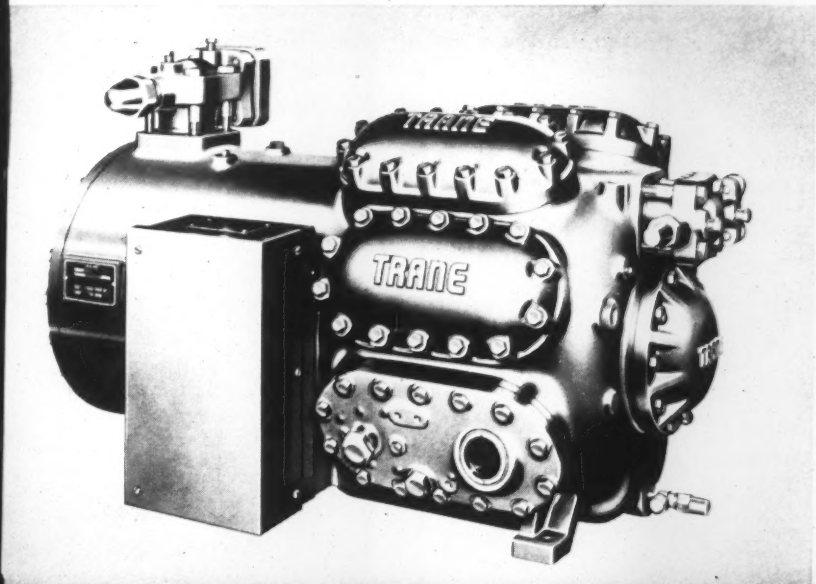
- **All major components,** chiller, condenser, compressor, designed and built by TRANE.
- **Advanced hermetic design** assures maximum efficiency, simplified maintenance and installation.
- **Compact size;** small enough to pass through a standard 36"-wide door.
- **Packaged design;** factory-wired and assembled to cut on-the-job labor. Pneumatic or electric control panel mounted and prewired.
- **Versatile.** May be used for any process or comfort liquid cooling application . . . to maintain constant temperature for electro-plating baths and other critical operations. Units available for use with evaporative or air-cooled condensers.

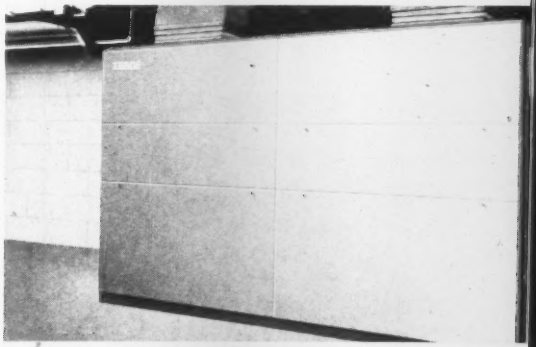
For any air condition, turn to

TRANE

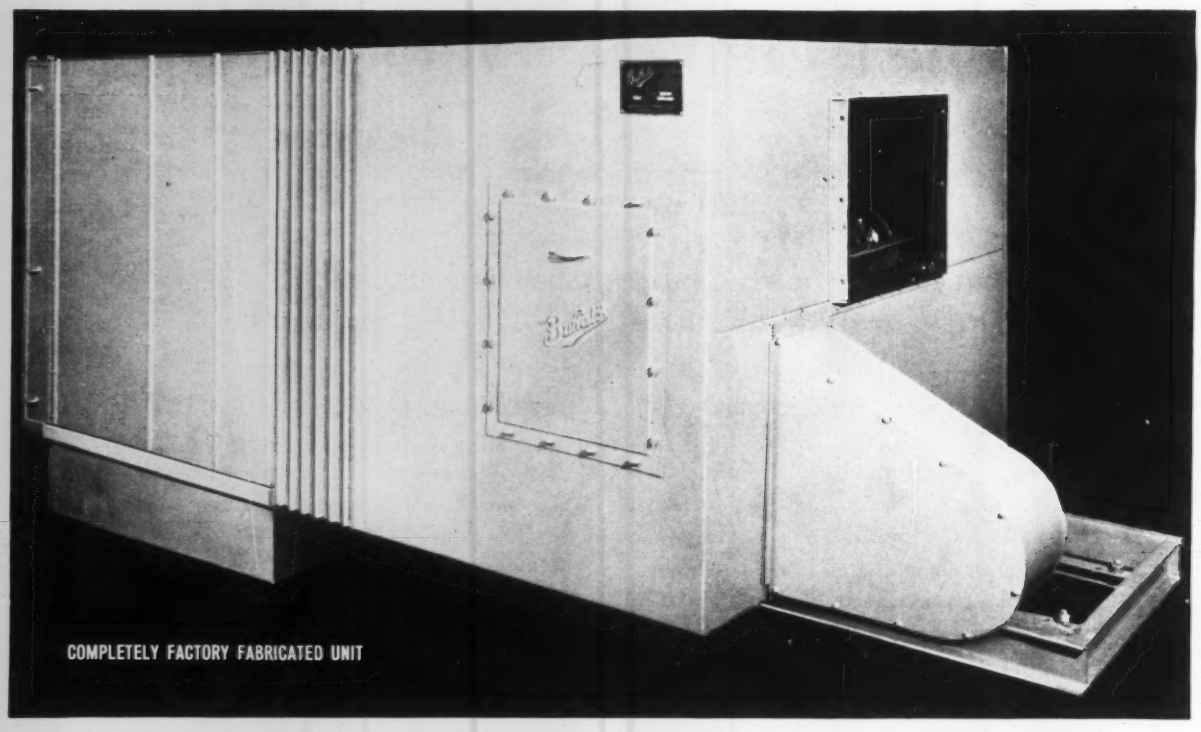
MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 100 U. S. AND 19 CANADIAN OFFICES





Trane Commercial Self-Contained Air Conditioners feature the new TRANE Hermetic Compressor. Quiet and compact, these units provide maximum cooling comfort for office, laboratory or factory areas. Job-matched to fit your budget, fit your needs. Air or water-cooled models in sizes from 10 to 50 tons.



NEW "BUFFALO" HIGH

INCREASED EFFICIENCY IN A MORE COMPACT SIZE

Here is a new high pressure (4" to 8" water gauge) air conditioning cabinet with many exclusive features. It is ideally suited to hospital operating rooms, laboratories and other high humidity installations.

Performing the functions of a standard central station cabinet, this new "Buffalo" unit also incorporates the washing, air cleaning, humidifying and evaporative cooling of an air washer.

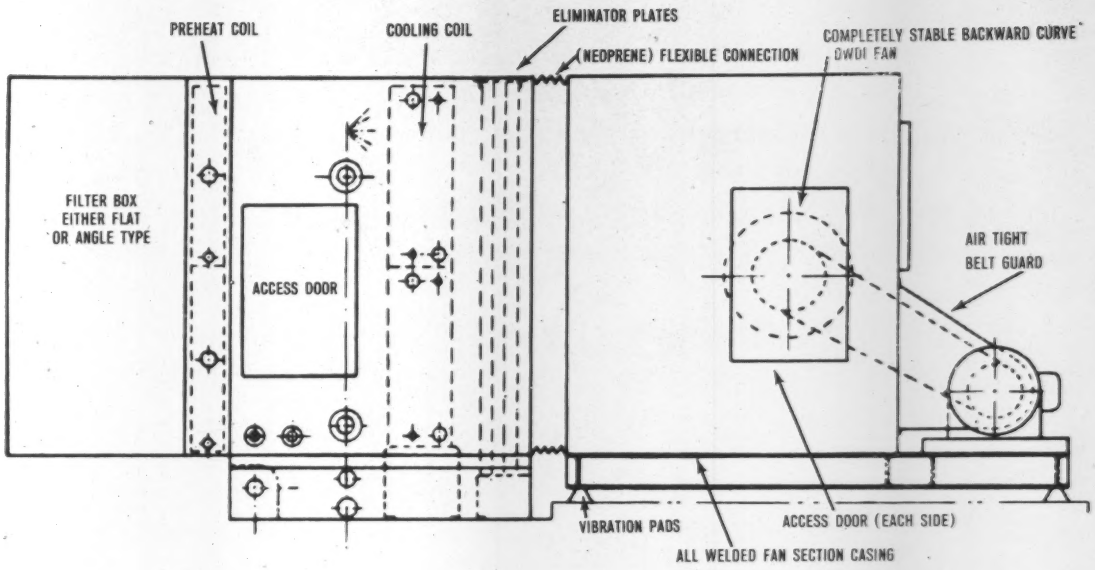
Water sprayed on the surface of the cooling coil permits the admission of a tremendous amount of moisture to the air stream. A high degree of saturation efficiency results so the air volume required for a given air conditioning load is reduced. **Thus, the size of cabinet, ducts and grills can be reduced.** Evaporative cooling produced by the recirculated spray water minimizes operation of mechanical refrigeration equipment during marginal weather.

"Buffalo"

BUFFALO FORGE

Buffalo Pumps Division Buffalo, N. Y.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT



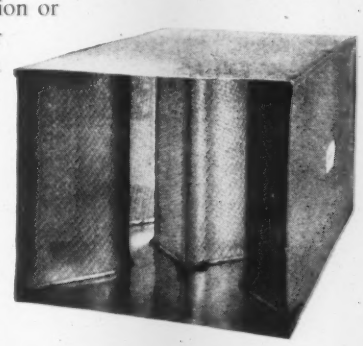
PRESSURE AIR CONDITIONING CABINETS:

A COMPLETE PACKAGE...BUFFALO "Q" FACTOR CONSTRUCTION THROUGHOUT

QUALITY CONSTRUCTION AND DESIGN features of the fan section include an all-welded heavy gauge casing with 1" internal insulation, completely stable backwardly curved double width, double inlet fan and special air-tight belt guard — all mounted on a common structural steel base. The washer section has a 12" deep heavy gauge welded tank. Spray system includes all interior piping, nozzles, float and make-up valves and separate mounted "Buffalo" Close Coupled Pump. Coil section spacer accommodates Aerofin copper tube, spiral wound copper fin, solder coated cooling coil and 3-bend galvanized eliminator plates. Entrained moisture cannot carry over to fan section.

ACCESSORIES include face dampers for intake side of fan section or washer section, angle or flat type filter box for cleanable or throw-away filters. An exclusive matched sound attenuator is shown below. This attenuator is located after the fan section and can be provided with insulated transformation piece.

CONTACT your Buffalo Engineering Representative for further information or write direct for Bulletin AC-150.



COMPANY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

COOLING • HEATING • PRESSURE BLOWING

FROM THE BOILER CAPITAL OF THE WORLD

100

THE TITUSVILLE-ATLAS

What kind of a heading is 100 x 1,000 for an ad about boilers? Well, it's not a magic formula . . . it just represents a simple fact—Titusville has produced and sold more than 100,000 boilers. That's why Titusville is known as *the boiler capital of the world!*

The complete TITUSVILLE-ATLAS unit, known for its BONUS POWER, is the result of the engineering know-how and experience that has gone into the production of those 100,000 boilers. TITUSVILLE-ATLAS—the only unit with a patented wet-back, assuring you of longer life . . . higher maintained efficiency . . . fewer repairs and more horsepower per total energy input.

VMA 6063

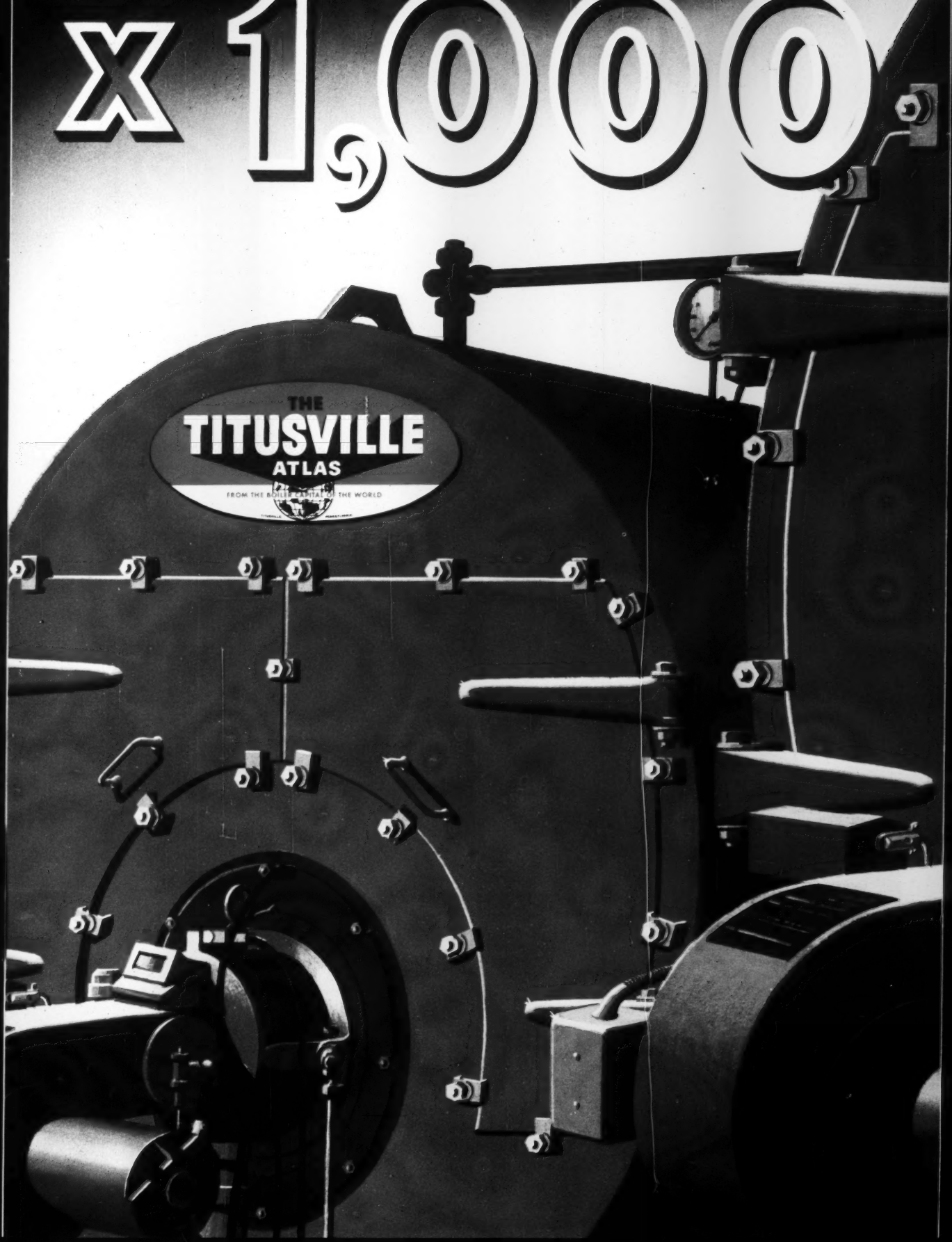
THE TITUSVILLE IRON WORKS COMPANY

TITUSVILLE, PENNSYLVANIA

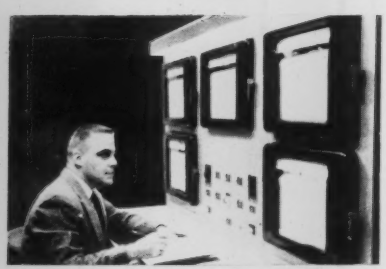
Division of Struthers Wells Corporation

Controlled cooled

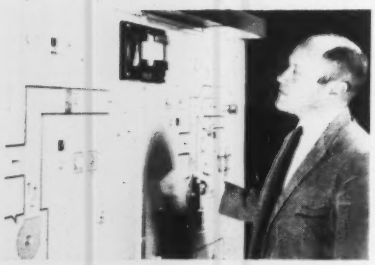
x 1,000



Centralized control



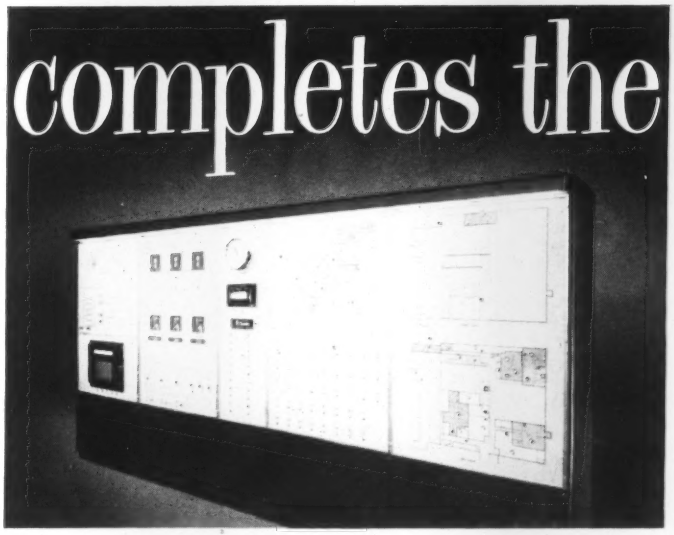
One "Electronic" recorder provides a permanent 24-hour record of temperatures at as many as 24 different points in the building.



A single "Electronic" eye-level indicator can be used to check temperatures at an unlimited number of points throughout a building.

One man can monitor all mechanical services, check and change temperatures, start and stop equipment, communicate with other areas.

completes the system



Centralized remote control of air conditioning, and other mechanical services is a highly profitable investment for the building owner. It places management and operation of the services in the hands of a single responsible supervisor. It eliminates endless running from point to point to check and correct temperatures and other variables . . . frees maintenance mechanics to do the work for which they are employed . . . reduces the size of the service staff required. By providing the opportunity for constant monitoring, centralized control saves fuel and power — and because it reports faulty functioning of any unit, it permits preventive maintenance to be performed before costly damage may be done.

Barber-Colman "Electrionic" control centers are the ideal answer. They do the job better — electrically. Simple and reliable, they provide instantaneous indication and control, eye-level readings, pushbutton operation and, where desired, a permanent recording of the performance of the system.

Functions which can be performed include temperature indication, recording, and adjustment, as well as start, stop, and indication of operation of valves, motors, blowers, pumps, fans, alarms, heating and refrigerating equipment, lighting, and other equipment.

Barber-Colman "Electrionic" control centers *complete* the system, assuring at all times ideal comfort conditions for the occupants of the building.

Ask for new Bulletin No. F-8944, which describes and illustrates control center values and explains the unique advantages of "Electrionic" control.

BARBER-COLMAN COMPANY

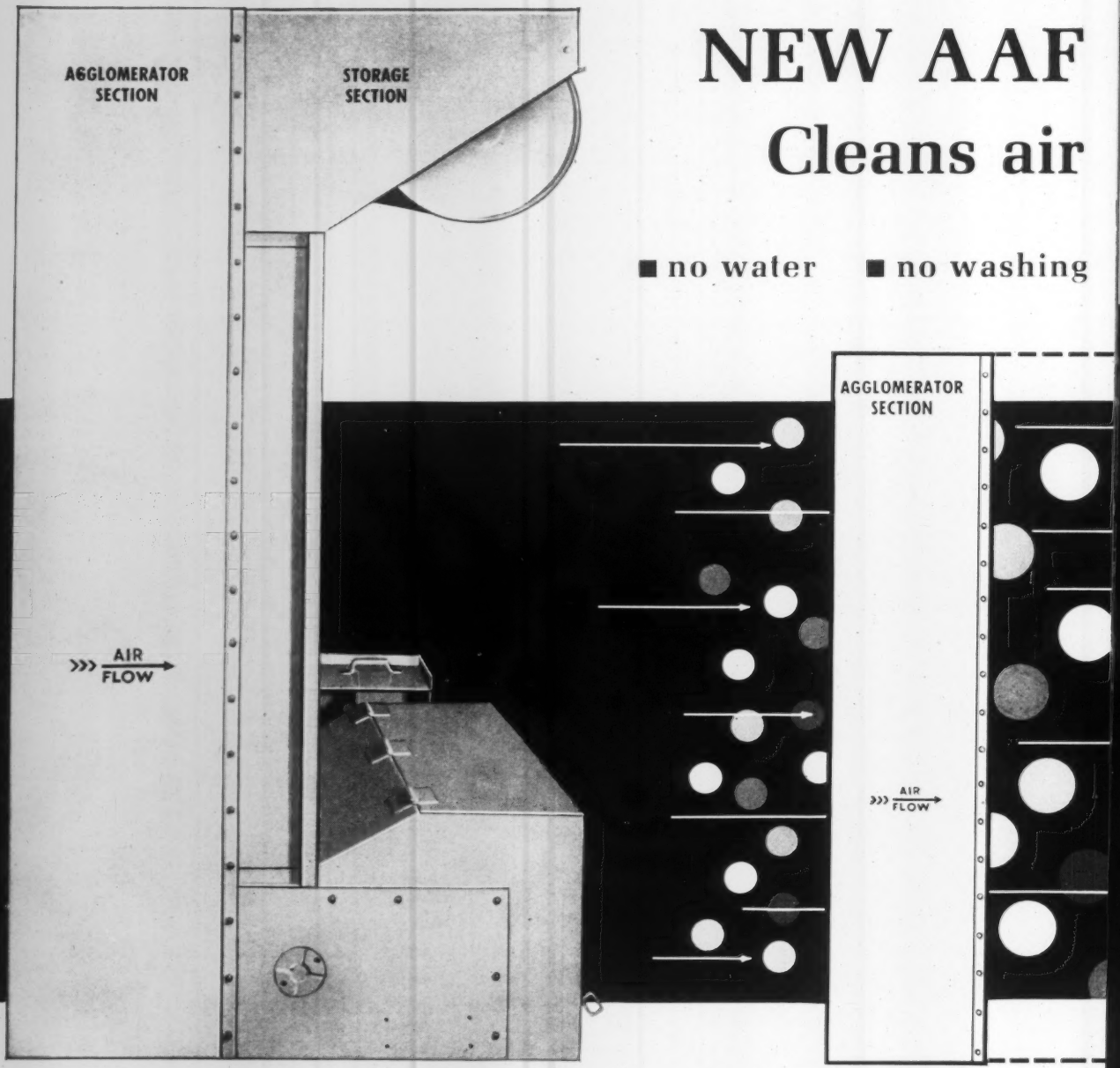
Dept. D, 1301 Rock Street, Rockford, Illinois

BARBER COLMAN

KEEP PACE ELECTRICALLY

NEW AAF
Cleans air

■ no water ■ no washing



Here is the only air filtration unit in the world that offers

- **the efficiency of an electrostatic precipitator, and**
- **the minimum maintenance of an automatic-renewing, disposable media air filter,**

both in one space-saving unit!

This revolutionary new air cleaner is the Rollotron. Its unique operating principle is shown in the exploded "flow diagram" illustration.

In overall size, the Rollotron requires no more space than any other electrostatic precipitator. Regardless of unit height or width, depth is only 39"!

1 TRAP THE DUST ELECTRONICALLY!

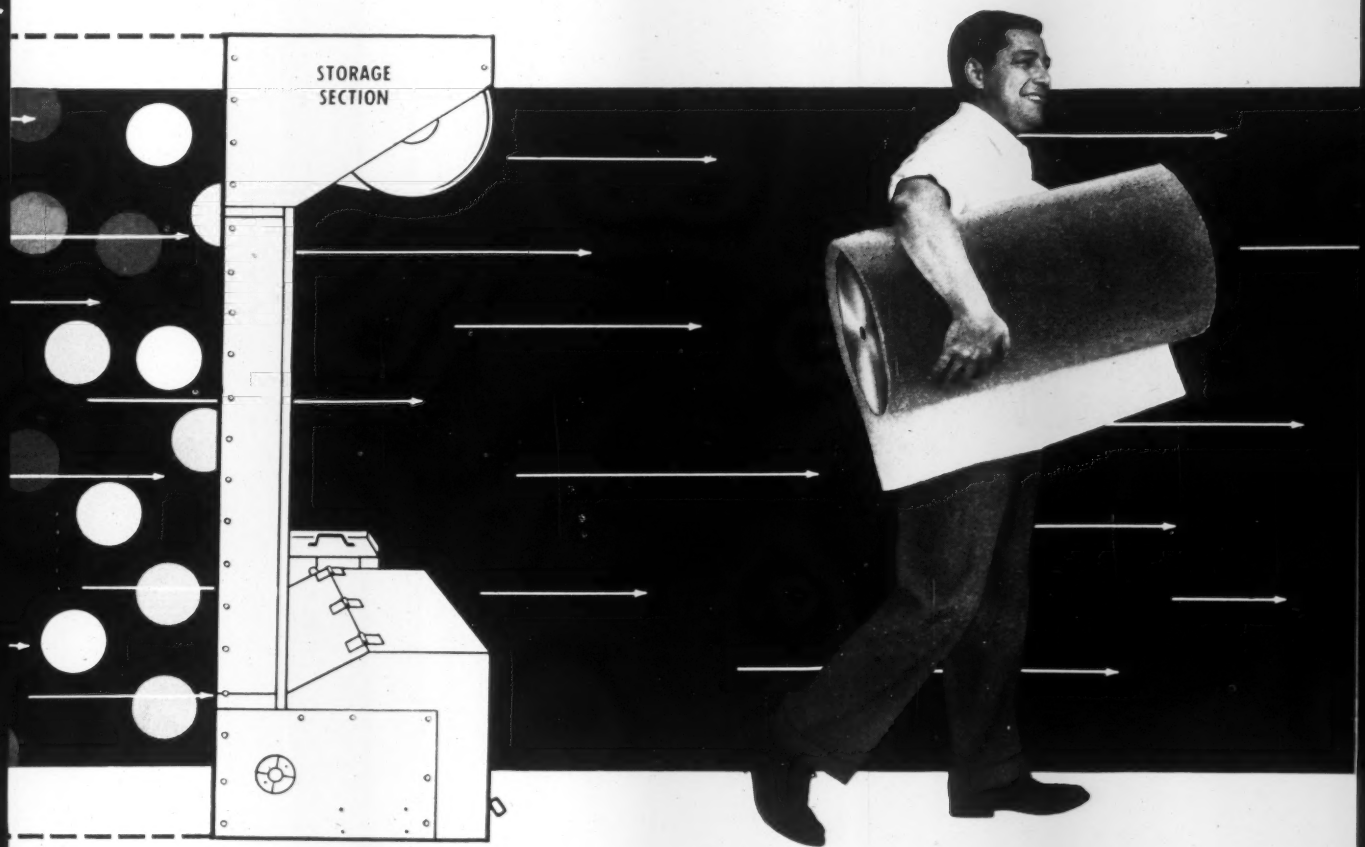
Minute dust particles are electrostatically attracted and adhere to each other on the *dry* plates of the agglomerator section. As the trapped dust particles build up (agglomerate) on the collector plates, the "mass" increases until the accumulation is swept off the plates by the air stream. Dirt is then carried onto the bonded glass fiber media of the storage section.

Maintenance on precipitator section? Virtually none. No oiling, no washing, no water, no freezing, no drains.

ROLLOTRON

electronically, rolls away the dirt!

■ no freezing problems ■ no drains ■ no oiling of plates



2 ROLL IT UP AUTOMATICALLY!

A bonded glass fiber "blanket" is fed automatically down the face of the storage section from a roll at the top. The used media—and accumulated dirt—are wound tightly into a compact roll at the bottom.

Maintenance? Simply replace the soiled roll with a clean one—an operation as simple as changing the film in your camera! In normal service, this is required only about once a year! The Rollotron makes scheduled maintenance a thing of the past!

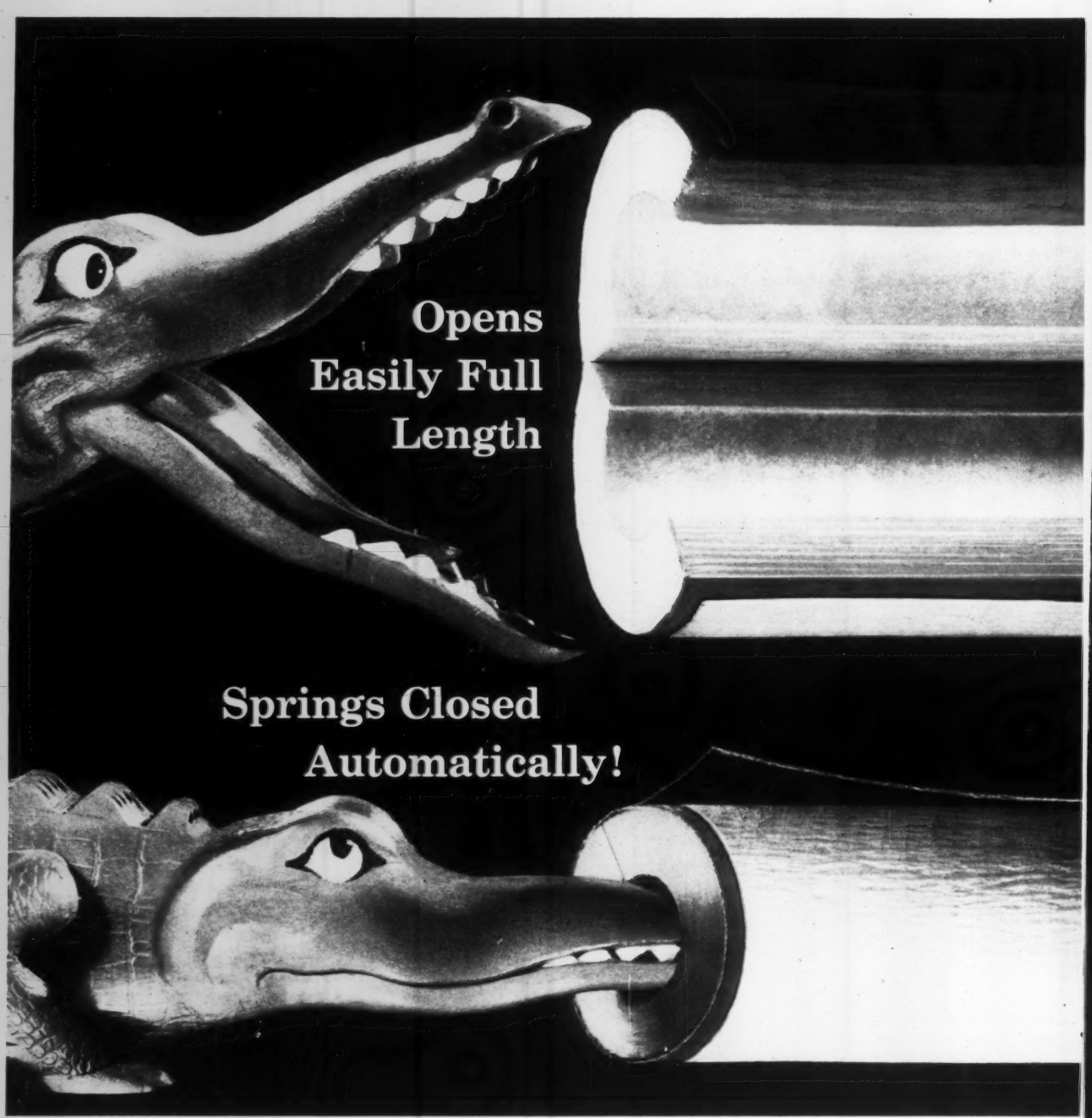
3 TAKE IT AWAY PERIODICALLY!

With quick, easy media replacement, the Rollotron is again ready to give maximum air cleaning—*electrostatic* air cleaning—for months to come!

For complete information on "electronically clean air by the roll" see your local AAF representative or write for Rollotron Bulletin 249. Address: Mr. Robert Moore, American Air Filter Company, Inc., 373 Central Avenue, Louisville, Kentucky.

AAF American Air Filter

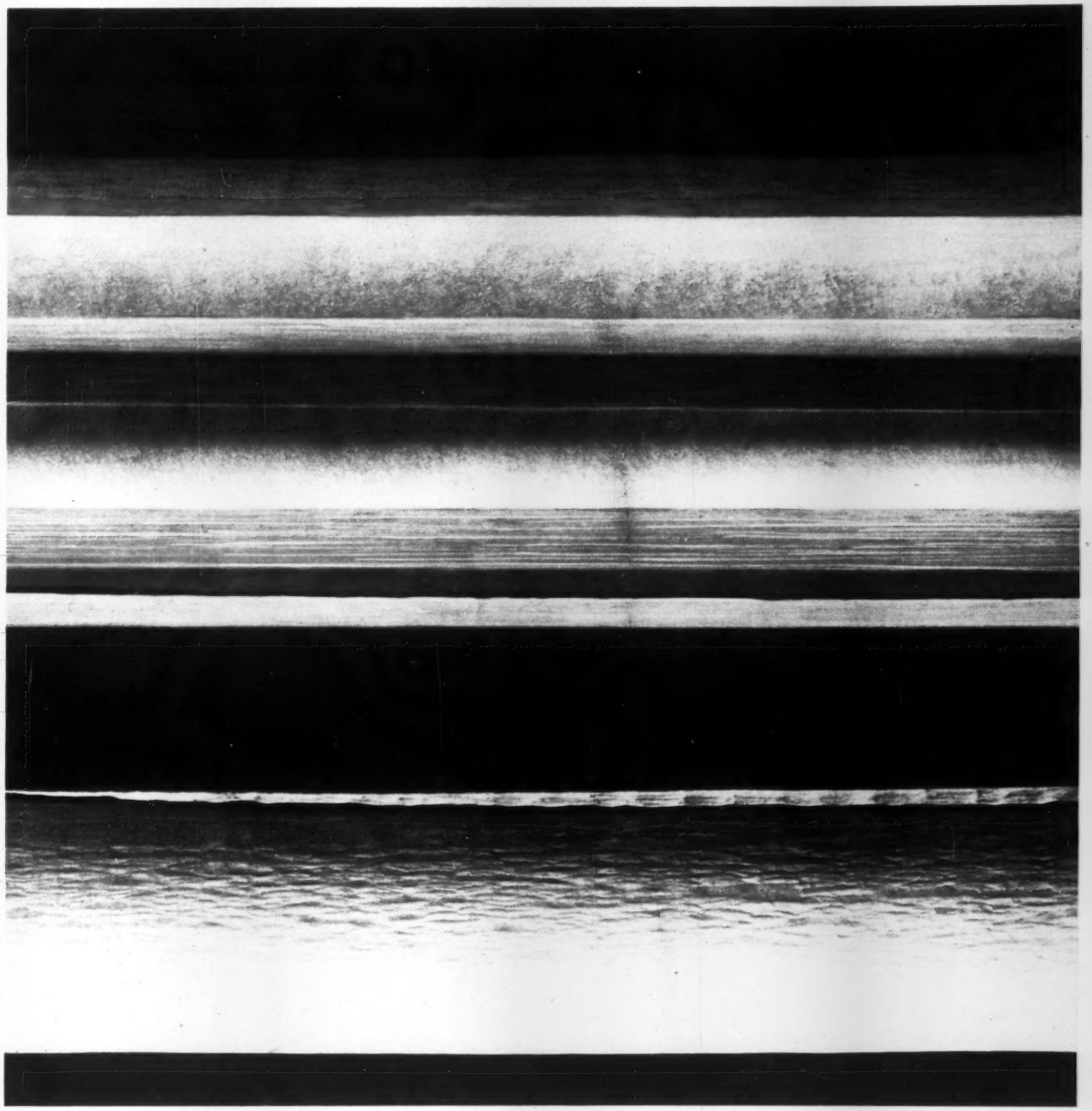
BETTER AIR IS OUR BUSINESS



Only J-M MICRO-LOK Fiber Glass Pipe Insulation Provides The Exclusive "Spring Hinge" Action!

Exceptional fiber resiliency and fiber alignment are the secret of Micro-Lok's easy-to-open, fast-to-close action. Only Johns-Manville Micro-Lok goes on so effortlessly, makes proper application so easy.

Micro-Lok has a remarkably low *k* factor which means lower fuel and power costs . . . gives hot or cold line protection from minus 120F to 370F above. The glass fibers in Micro-Lok do not absorb moisture . . . will not rot, shrink or swell.



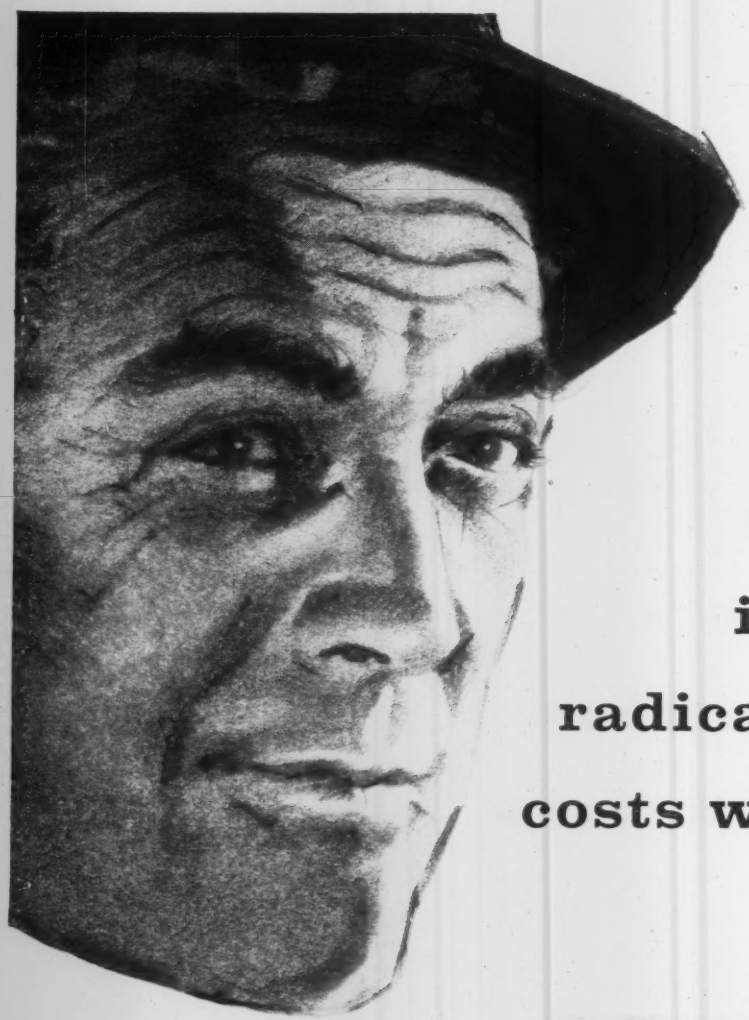
Outside surface is smooth . . . has a neat appearance. It comes in a choice of factory-applied canvas, regular and flame-resistant vapor-barrier jackets. Available for all pipe and copper tubing sizes in standard thicknesses.

Contractors like the way Micro-Lok saves them job hours. It's featherlight, yet resilent enough to take rough handling. Drop it, bang it—no damage! Accurate inside diameter assures snug fit, and Micro-Lok is easily cut to fit joints, hangers or other irregularities.

Complete information from the nearby J-M Representative. Or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ont.

JOHNS-MANVILLE FIBER GLASS

JOHNS-MANVILLE JM PRODUCTS



Look at how contractors are speeding installations, radically reducing costs with Greenlee

JOB-

As the bidding gets tighter and the profit squeeze grows tougher, today's smartest contractors are "tooling up" in every practical way to streamline operations — and to *control* costs!

Many are finding the answer in *Job-Profit Tooling* by Greenlee. It mechanizes much of the work previously done by hand, saves costly materials — assures extra efficiencies, better final results, *more net profit per job!*

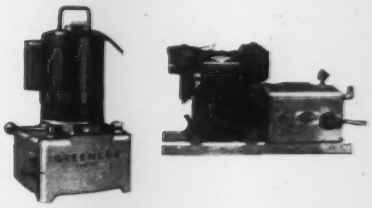
To illustrate — the Greenlee Lightweight Hydraulic Pipe Bender at right makes a 90° bend in 3" pipe in approximately one minute, with *one ram stroke.* Models available for making any bend up to 90° in ½" - 2"; ½" - 3"; ½" - 4"; and 1¼" - 6" pipe. Attachments available for bending steel, copper, brass, and aluminum tubing. See facing page for other ways to save time, cut costs with Greenlee Job-Profit Tooling.

For fast installation of underground pipe

With a Greenlee Hydraulic Pipe Pusher on the job you quickly, easily push pipe underground . . . without tearing up pavement, sidewalks, tracks, floors, lawns. Eliminates extensive trenching, tunneling, backfilling and repaving. Just a short trench accommodates the pusher to save you hours of excavating work. Greenlee Hydraulic Pipe Pushers are extensively used to make underground installations of pipe for gas, water supply, industrial processes, and other purposes; conduit for electricity and telephone cable. Many owners report that this equipment often pays for itself in labor savings alone on the first few jobs.

Pipe Pusher No. 790 for ¾" - 4" pipe sizes. Six speeds, up to 40 tons pushing pressure. Average pushing speed 2 feet per minute when equipped with No. 797 power pump.

Pipe Pusher No. 795 for pipe larger than 4", concrete sewer and corrugated drainage ducts. Six speeds, up to 75 tons pushing pressure. Both models can be operated with hand or power pump.



For faster operation of pipe benders, pushers — Convert from hand to power pump. Many contractors are finding the value of power operation over their previous hand-operated equipment. Power pumps increase pipe bending speed from 3 to 5 times, proportionally increase pipe pushing speed. A complete line of Greenlee hydraulic power pumps available with electric motors or gasoline engines — in various models to meet your job requirements — all with 10,000 psi maximum pressure. Illustration above (left) shows the popular Greenlee No. 798 AC-SA pump with ¾ hp, 110-220 volt a-c electric motor. (Right) No. 797-G-SA pump with 4½ hp gasoline engine. Also available with rubber-wheeled undercarriage.

PROFIT TOOLING

For bending small pipe — New Greenlee Ratchet Benders speed and simplify bending of pipe (½" - 1½") with ratchet action that permits short, powerful strokes. Makes any bend up to 90° and is equipped with built-in bending gauge, 0° to 90°. Swing-away pipe clamp permits fast, easy loading. Can be operated on its T-iron base or equipped with standard pipe legs as shown at left. Two models: No. 1800 for ½", ¾", 1" pipe, No. 1801 for 1¼", 1½" pipe.

Also available from Greenlee, hand benders for fast, easy bending of copper, brass, and aluminum tubing. Copper tube benders make bends up to 90°. Tubing and pipe benders make bends up to 180°. Various models and sizes.

For boring pipe-size holes —Greenlee multispur bits bore holes in wood for following sizes of pipe: ½", ¾", 1", 1¼", 1½", 2". Use with power drill or bit brace. Sets of six packed in metal box.

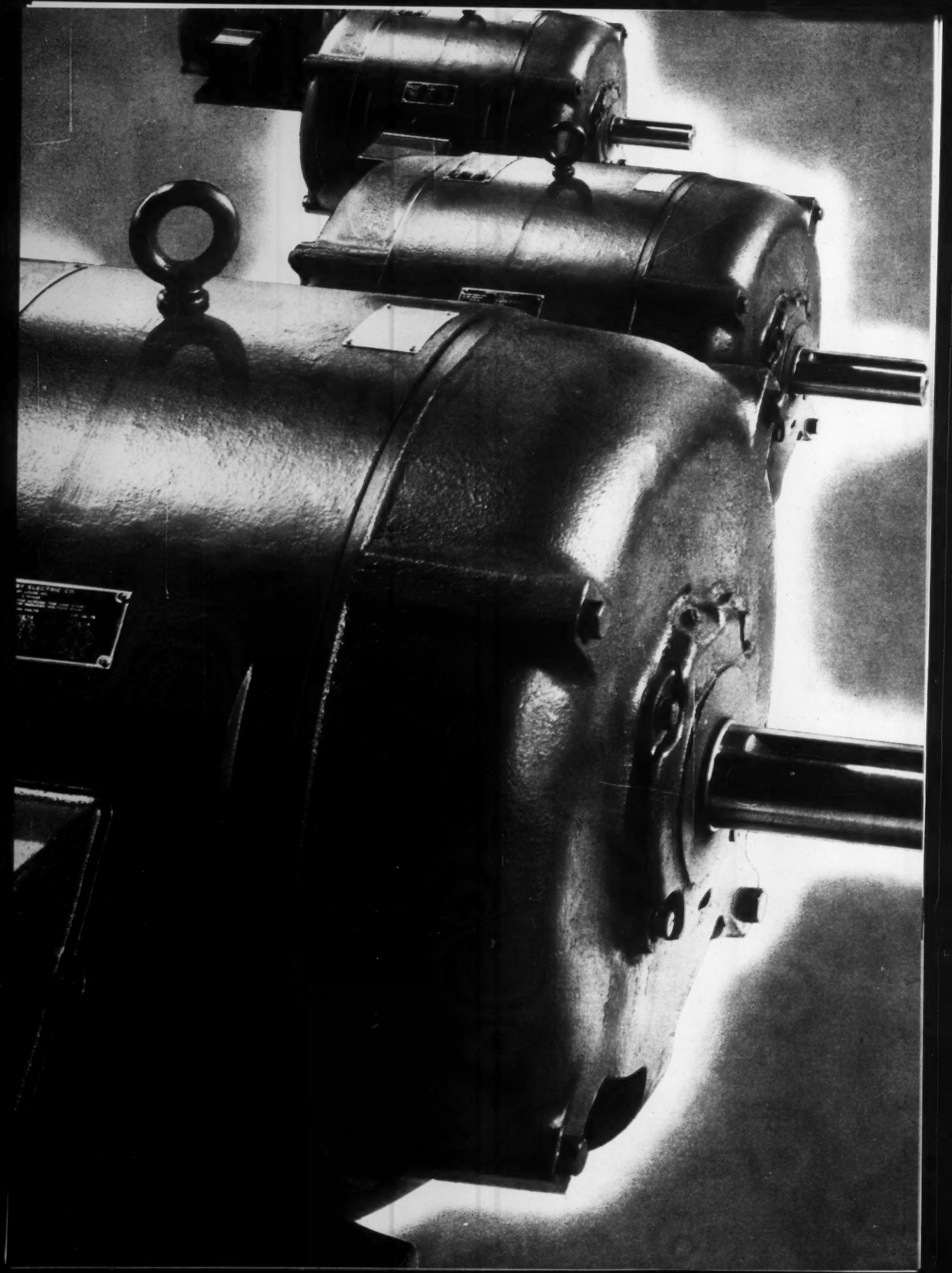
Write for new illustrated quick-reference Bulletin E-240.

GREENLEE TOOL CO.
1887 Columbia Ave., Rockford, Ill.

TOOLS FOR CRAFTSMEN
GREENLEE

JOB-PROFIT TOOLING

. . . cost control for contractors



1960–16,450,000 horsepower
1965–26,000,000 horsepower

Conservative estimates place the total horsepower of all motors driving fans and blowers in the United States at about 16,450,000 horsepower. And in 1965 it is estimated that the total will be about 26,000,000 . . . an annual growth of 5% for the air moving industry. To make sure all this equipment gives top performance requires careful matching of motor to equipment . . . and a wide variety of different types of motors. Century Electric application engineers can help you select the right motor for your fans, blowers and allied equipment:

For fans—Two basic types of motors, CS and CP, meet most requirements for fans operating from single phase power. Both these Century Electric capacitor start motors provide high starting torque. Fans operating from polyphase power perform best with SC and SCM motors.

For blowers—If the starting load is light or if there will be short time increases in load, then the Century Electric Type SC polyphase motor is ideal. It will give you enough starting torque, and with low starting current. It comes in ⅙ to 400 hp sizes. If you need two, three or four different fixed speeds while the blower is running, the Century SCM polyphase motor will do the job.

For compressors—Where high starting torque is required to overcome great inertia or backpressure, the Century Electric Type SCH polyphase motor is right. This motor comes in sizes ranging from three to 400 hp and in dripproof, totally-enclosed and explosion-proof enclosures. It also provides the right kind of power to drive reciprocating pumps with high starting torque requirements.

For pumps—Centrifugal pumps, whose torque demands increase with speed, perform best with Century Electric SC polyphase motors. Reciprocating pumps with high starting torque requirements need the SCH. For all types of pumps, as well as for compressors and blowers, Century Electric makes single phase motors.

For special applications—Century Electric makes a variety of motors for specific operating conditions. The shaft-mounted fan motor is designed for unit heaters and evaporators. It comes in ⅓ to 3 hp sizes. Hermetic motors can be built right into a refrigeration compressor unit . . . they are manufactured under rigid quality controls to make sure they are free of contaminants that could damage capillary tubes and valves.

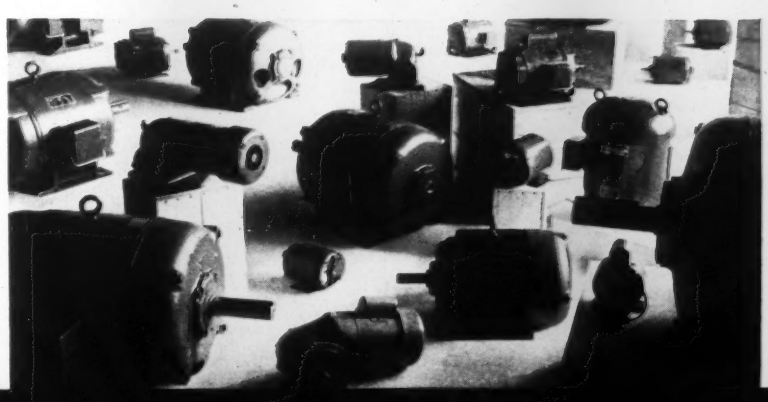
FOR MORE INFORMATION—Please contact your nearest Century Electric Sales Office or Authorized Distributor. You will find Century Electric's new Motor Application Guide helpful . . . please write for bulletin 270A. For *more* than a motor . . .

CENTURY ELECTRIC COMPANY

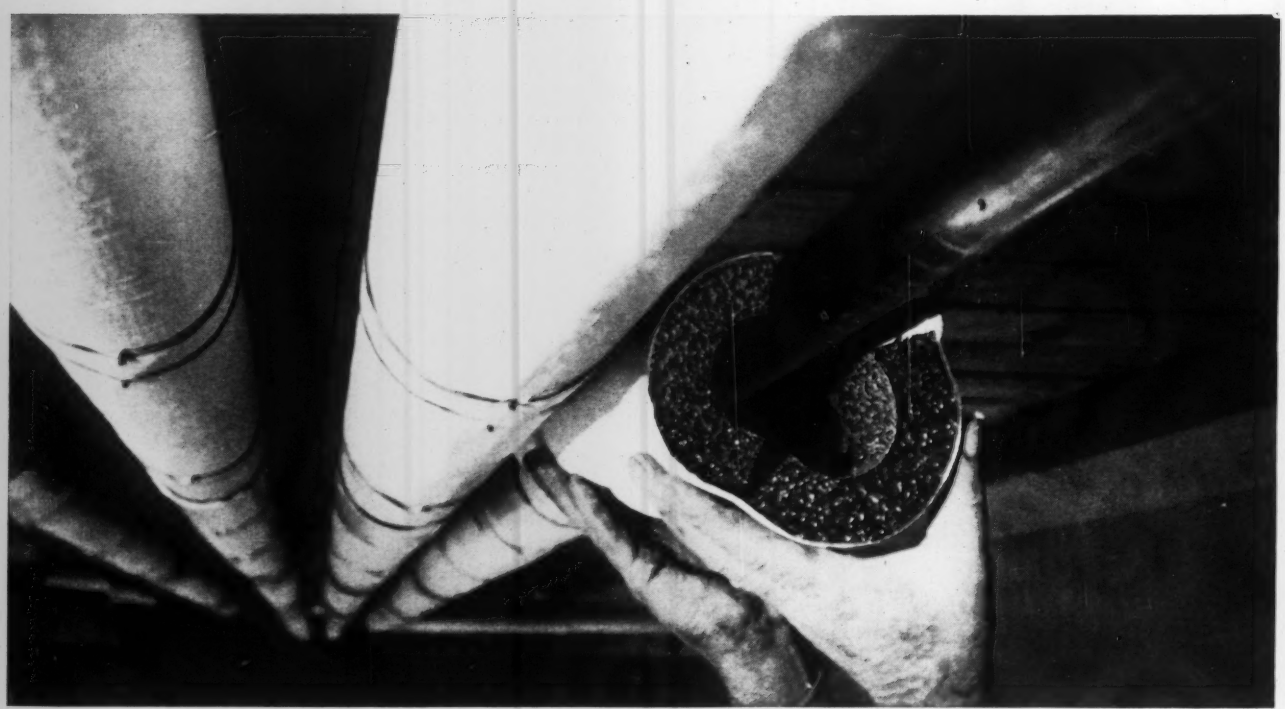
St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century 59-8A

FROM OVER 10,000 TYPES of motors—AC and DC . . . single phase and polyphase . . . from 1/20 to 400 hp—you can find the right one from Century Electric for your application . . . the one that provides the best performance commensurate with cost.



3 NEW SIZES permit a complete FOAMGLAS® STAY-DRY installation on building service lines

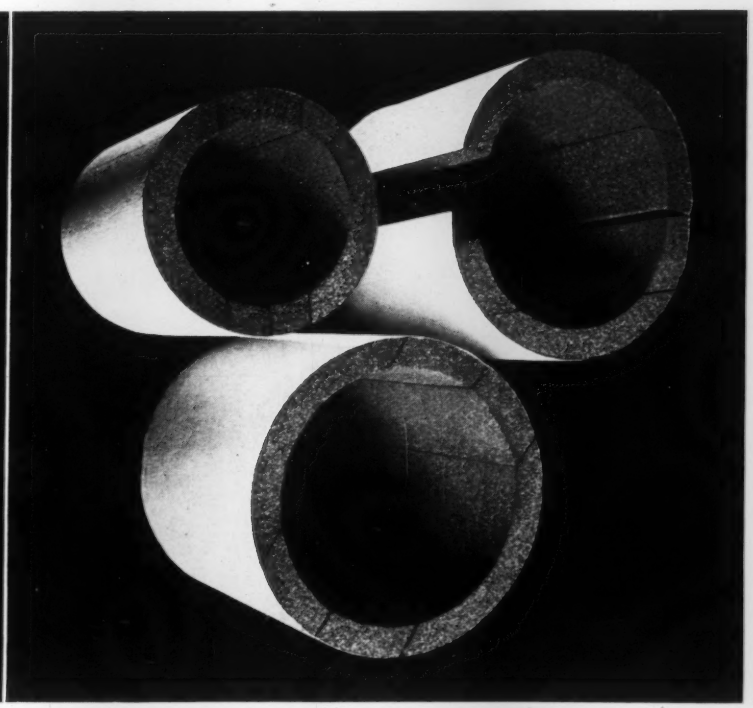


Consulting Engineers Bouillon, Griffith and Christofferson used FOAMGLAS STAY-DRY Pipe Insulation to protect some 18,000 ft. of heating-cooling lines in Seattle's new Norton Building. They found: easy application; no extra vapor seals or moisture cut-offs required; high compressive strength prevents sagging; condensation on the lines eliminated.

Demand for an increased range of specifications often marks full acceptance of a new product. That's just what's happened to FOAMGLAS STAY-DRY Pipe Insulation . . . introduced last year as a new, low cost way to apply the constant insulating value of FOAMGLAS to building service lines. Enthusiastic acceptance has dictated the immediate addition of three new sizes . . . 8", 10" and 12" I.P.S. A variety of fitting covers and elbows are also available (shown and described below) to make possible a complete FOAMGLAS installation.

Now you can obtain the unmatched moisture resistance of FOAMGLAS in 24" lengths with a factory-applied Kraft-foil laminate jacket in 1" and 1½" thicknesses *for all lines from ½" tubing to 12" I.P.S.*

Consider the many benefits this unique new pipe insulation has delivered on jobs like the Norton Building described below. Consider the increased range of piping applications which can now receive these benefits. Then put this valuable performance to work for you. For detailed information, write Pittsburgh Corning Corporation, Dept. HP-40, One Gateway Center, Pittsburgh 22, Pennsylvania.

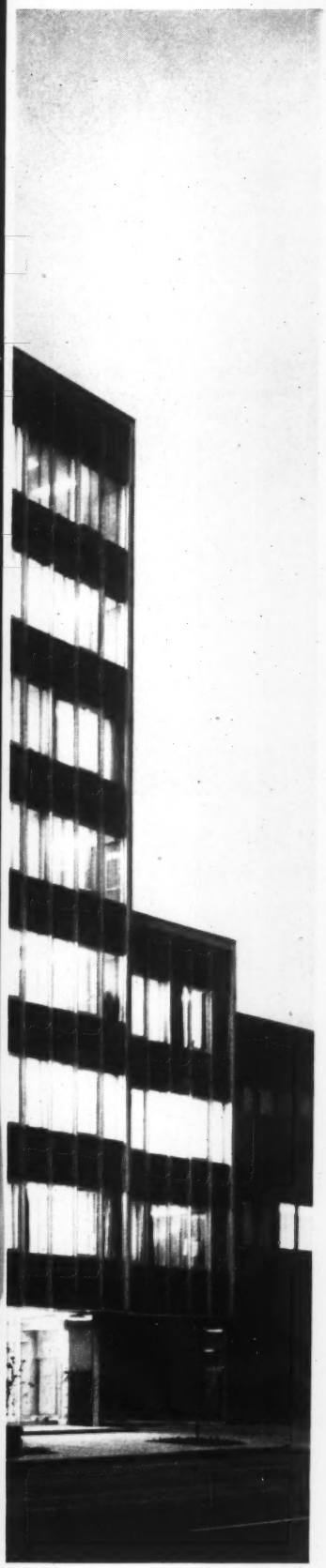


Fitting covers and elbows are furnished for all fittings used in piping systems up to 12" I.P.S. Now the complete piping systems can gain all the benefits of FOAMGLAS STAY-DRY Pipe Insulation.

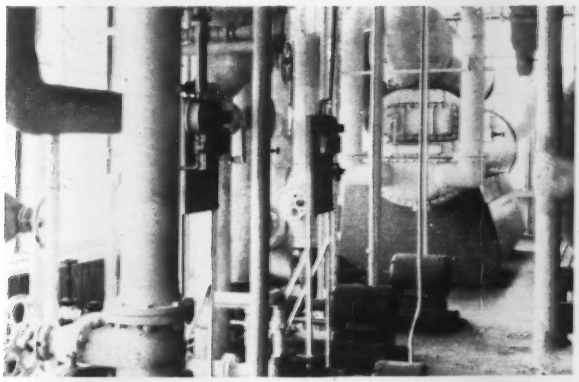
3 NEW sizes to fit 8", 10" and 12" I.P.S.—now make it possible to apply FOAMGLAS STAY-DRY Pipe Insulation to virtually every size of pipe normally used for any building service function. Suggested temperature range is from +35°F to +350°F.

PITTSBURGH PC CORNING

This new 3101 Euclid Avenue Building in Cleveland meets every modern requirement in the book. Attractive exterior, with glass and aluminum curtain walls. Most comfortable interior, with air conditioning by Gas-operated Carrier Absorption Refrigeration.



Attracts tenants with comfort cooling by GAS-operated CARRIER Absorption Refrigeration



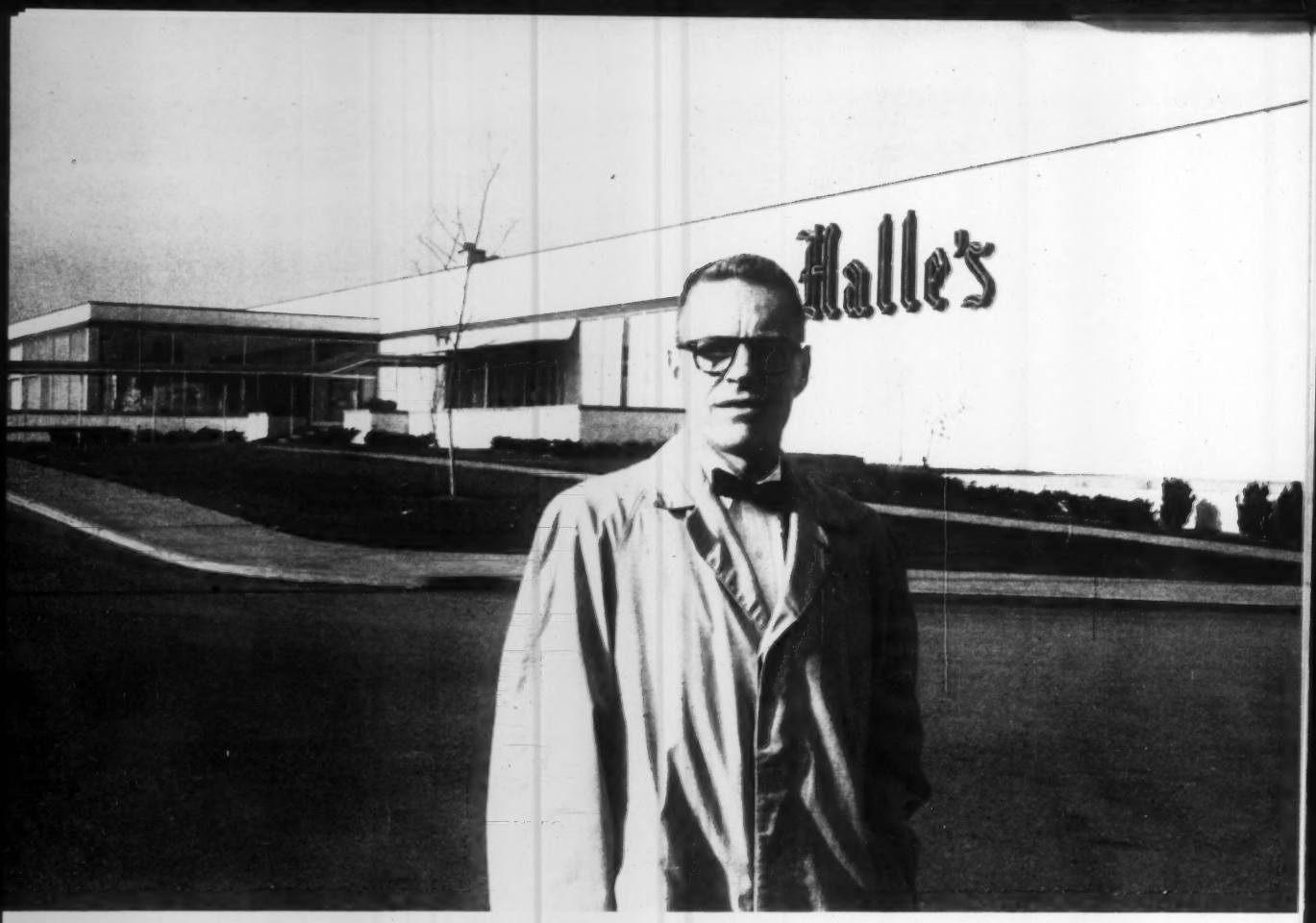
AIR CONDITIONING PENTHOUSE. This equipment in penthouse atop the building includes two gas-fired Bryant boilers, 300-ton capacity Carrier Absorption unit to chill water for the Carrier Weathermaster air conditioning system, and Carrier cooling towers, too. Roof-top installation frees basement area for other uses.

H. L. Vokes Company of Cleveland, designers and builders of the new 3101 Euclid Avenue Building in that city, are experts in two-way satisfaction. They satisfied their tenants and their own cost requirements with one of the most efficient types of modern air conditioning– Gas-operated Carrier Absorption Refrigeration.

Comfort cooling in this building starts at the same two gas-fired boilers that furnish heat in winter. The Carrier absorption unit uses low pressure steam from the boilers as the energy source for water chilling. Thus, no prime mover is needed. Boiler capacity is put to use on a year 'round basis. And thrifty gas keeps fuel costs low.

Judge for yourself the efficiency and economy of Gas-operated Carrier Absorption Refrigeration. Specific performance data and cost details are yours for the asking. Just call your local gas company, or write to Carrier Corporation, Syracuse 1, New York. AMERICAN GAS ASSOCIATION.

FOR HEATING & COOLING GAS IS GOOD BUSINESS



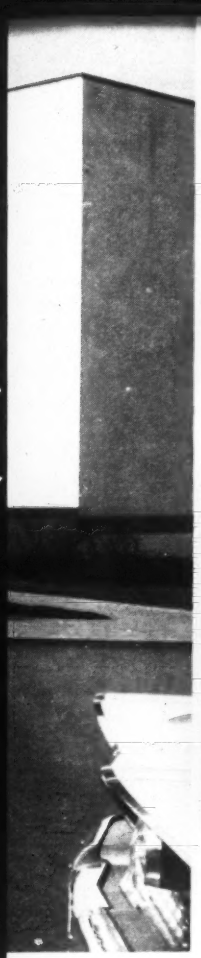
J. L. VanNort, Midwest Regional Sales Manager. Shoppers are cool and comfortable in Halle's modern store in suburban Cleveland, Ohio, which utilizes two 200 hp. Reliance Hermetic Refrigeration Motors that drive two-stage centrifugal compressors.

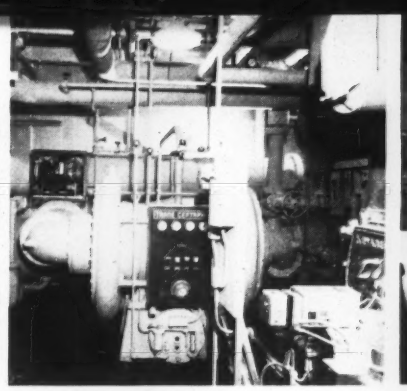
"Duty Master *has* what air conditioning customers expect in a motor... uninterrupted, trouble-free operation

"The new Duty Master A-c. Motor has all the inherent design characteristics that keep it operating when you need it most. There's a Duty Master built for *every phase* of an air conditioning system . . . from the giant Hermetic motors to rough, outdoor applications. Many of the reasons for Duty Master's adaptability to this field stem from its qualities of built-in protection. So you get the benefits of low maintenance and *uninterrupted service.*

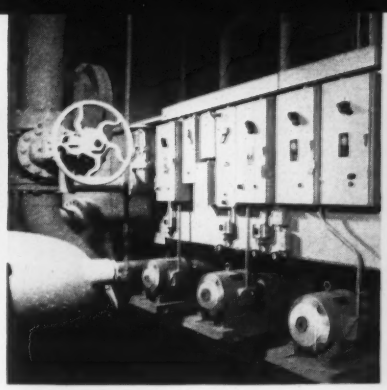
"Our Reliance engineers work constantly with equipment builders, consulting engineers, contractors and end users . . . to come up with sound applications of Duty Master Motors that completely match their needs."

RELIANCE — R — Duty Master A-C. MOTOR

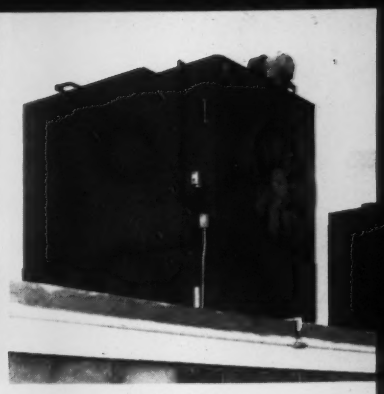




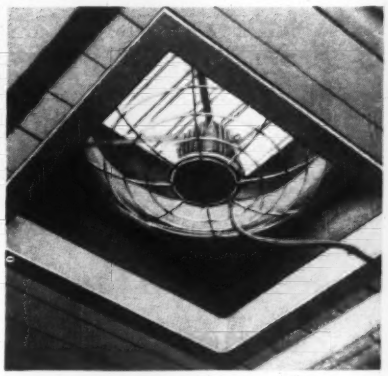
Centrifugal Compressors



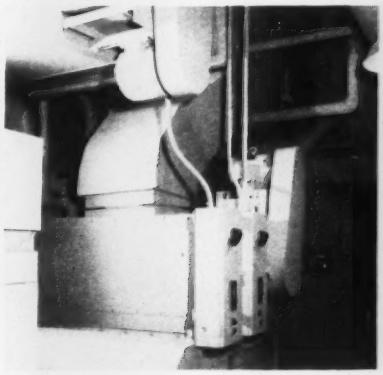
Chilled Water Pumps



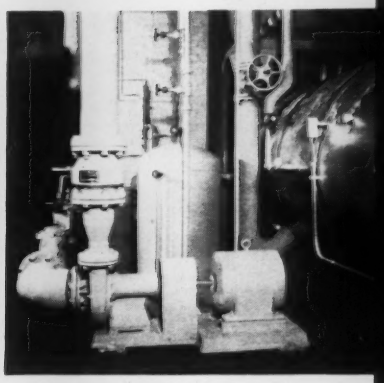
Cooling Towers



Exhaust Fans



Air Handling Equipment



Boiler Feed Water Pumps

Duty Master: electrical stamina—mechanical strength

The pictures of other installations tell the story of Duty Master's full-system service. Vitally important is the Hermetic Lecton*-insulated Refrigeration Motor, driving a centrifugal compressor. It repels freon, oil, water and heat . . . retains dielectric strength and resists flaking. Cuts maintenance and uncomfortable down-time. Accelerated 5-year tests show no insulation deterioration or breakdown, even when motor is operated continuously at 300°F! It's available from 10 to 1000 hp.

In other applications shown, the quiet Duty Master does a competent, uninterrupted job. It is not affected by dust, dirt or moisture. Multiple-dipped insulation, plus metered lubrication system (Metermatic) give you the built-in protection so necessary for efficient operation. Maintenance is at a minimum.

*DuPont Registered Trademark

For special applications, such as gas absorption systems, the Reliance Submersible Motor can be safely immersed in water, oil, or liquid chemicals, in this case lithium bromide. Exclusive Reliance "Liqui-Seal" construction seals oil in, foreign contaminants out.

Reliance gives you a wide variety of modifications for any air conditioning application . . . pump-mount adaptors, vertical NEMA C-Face and D-Flange motors, P-Base motors . . . in all enclosures. Duty Master A-c. Motors are now available, ready to ship, in 1 through 250 hp. ratings.

Your nearest Reliance Sales Engineer or distributor can show you why the Duty Master line is so completely suited to your air conditioning requirements. Call him. If you choose, write for detailed information—Bulletins B-2507 and B-2505.

B-1649

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

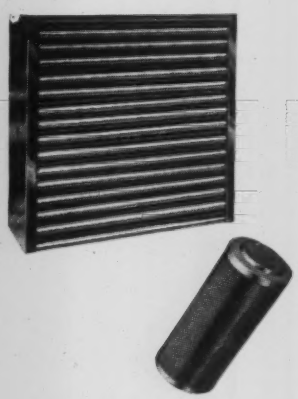
RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 364A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
Sales Offices and Distributors in Principal Cities

Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

HOW DOREX AIR RECOVERY annually cuts air conditioning costs by 78%

Over a 20-year period, the dollar difference is incredible, the penalties of owning and operating cost are tremendously reduced . . . if an air conditioning system uses DOREX to recover already conditioned air rather than use 100% outside air.



DOREX is designed in two basic types—C Cells and H Canisters. Because of their arrangement flexibility, canisters are especially suitable where installation space is limited or irregular.

ESTIMATED DIFFERENTIAL OF OWNING AND OPERATING COSTS, OUTDOOR AIR vs RECOVERY AIR FOR 1000 CFM

ITEM		OUTDOOR AIR	RECOVERY AIR
	ANNUAL FIXED CHARGES		
1.	Amortization, 20 years, cost per year	$ 78.10	$ 17.50
2.	Interest rate, 4 percent [(20 yr + 1)/(2 × 20 yr)] × 0.04 × initial cost	32.00	7.35
3.	Taxes and insurance (neglected)	0.00	0.00
4.	Total annual fixed charges	110.10	24.85
	ANNUAL MAINTENANCE COSTS		
5.	Repairs, refrigerating equipment $1.20 per ton	4.56	
6.	Refrigerant 0.44 per ton	1.67	
7.	Oil and grease 0.12 per ton	0.46	
8.	Repairs, heating gross	5.00	
		11.69	
	ANNUAL SERVICE COSTS		
9.	Electric power, refrigeration (0.746 × hp × cooling hours)e* = 3220 kwhr		
10.	Cost of electric power 1.5¢ per kwhr		
11.	Refrigeration power costs (Items 9 and 10)	48.20	
12.	Water at 11 cents per 1000 gal (neglected with cooling tower)		
13.	Heat requirement 4.5 × 1000 × 11.7** × 2200/e* = 165,000MBtu		
14.	Gas cost, $1.00 million Btu		
15.	Heating cost (Items 13 and 14)	165.00	
16.	Recovery fan power, 0.0001573 × 1000 head = 0.063 hp		
17.	Recovery fan power, [0.746(16) (2200 + 810)]/e = 188 kwhr		
18.	Recovery fan power costs (Items 10 and 17)		2.82
19.	Labor to change recovery cells		2.00
20.	Freight to ship used and recharged units		10.00
21.	Regenerate, recover cells		35.00
		213.20	49.82
	SUMMARY		
	Annual fixed charges	110.10	24.85
	Annual maintenance costs	11.69	
	Annual service costs	213.20	49.82
	Total annual owning and operating costs	334.00	74.67
	Annual savings with air recovery		260.32
		334.99	334.99

*Efficiencies are taken in items 9 and 13 as 70 and 75 percent respectively.
**Difference in enthalpy, Btu per lb of dry air, between inside and outside, for average winter conditions.
From a paper by Warren Viessman, Heating, Piping & Air Conditioning—Sept. 1959

By recovering used, already conditioned air, extracting from it the accumulated impurities, and converting it to original freshness, DOREX brings about maximum economy in air conditioning. Detailed information on the unique DOREX process and equipment is available. Simply request—on your letterhead, please—Bulletin 108A and "Air Conservation Engineering". Contact the representative near you or write to Connor direct.

CONNOR ENGINEERING CORPORATION

DANBURY • CONNECTICUT

CONNOR ENGINEERING CORPORATION dorex® air recovery

. . . the most experienced professionals in air recovery and purification.

Just 75 years ago, heating was about as unpredictable as the weather, as temperatures alternated between shivery low and smother-high. Then a Wisconsin schoolteacher named Johnson decided to do something about classroom comfort and thereby launched a new industry!

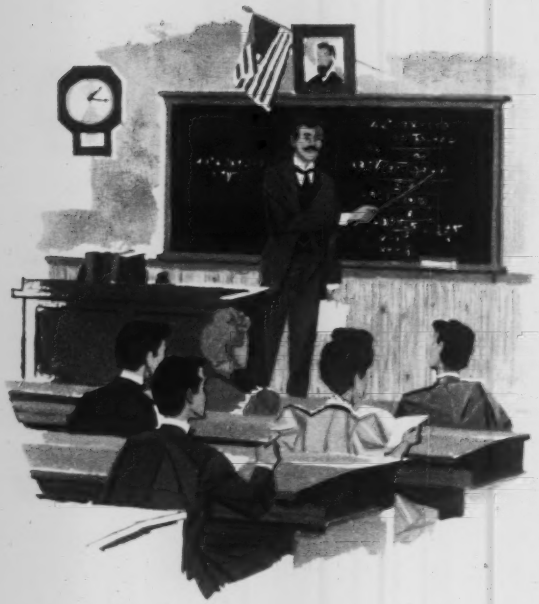
The Story of the Thermostat

Actually this is the story of a symbol . . . the symbol of an industry that has brought comfort, safety, better health, and efficient working conditions to people all over the world.

. . . In a specially equipped manufacturing plant, delicate missile parts and components, with micro-inch tolerances, must be made under temperature and humidity conditions that never vary. At every step in their manufacture, modern pneumatic controls assure error-free regulation of the thermal environment.

. . . In a hospital, surgeons perform a lifesaving operation. Accurate pneumatic controls maintain the temperature and humidity at preselected levels to conserve the patient's strength during surgery.

. . . Every morning of the school year, millions of students sit down to study and learn in comfortably heated and ventilated or even air-conditioned classrooms. To help provide this ideal environment, the great majority of schools and colleges everywhere depend on precision pneumatic control systems.



. . . Far at sea, one of the nation's deadly new submarines cruises undetected, an elusive, power-laden sentry of the "Silent Service." Her crew lives and works in comfort and safety — in a climate precisely regulated by a pneumatic control system.

. . . Across the continent, pneumatic controls assure safe air conditions in the highly critical processing areas of an atomic energy facility. Pneumatic controllers of extreme sensitivity operate constantly to assure safe disposal of waste air and prevent the escape of contamination.

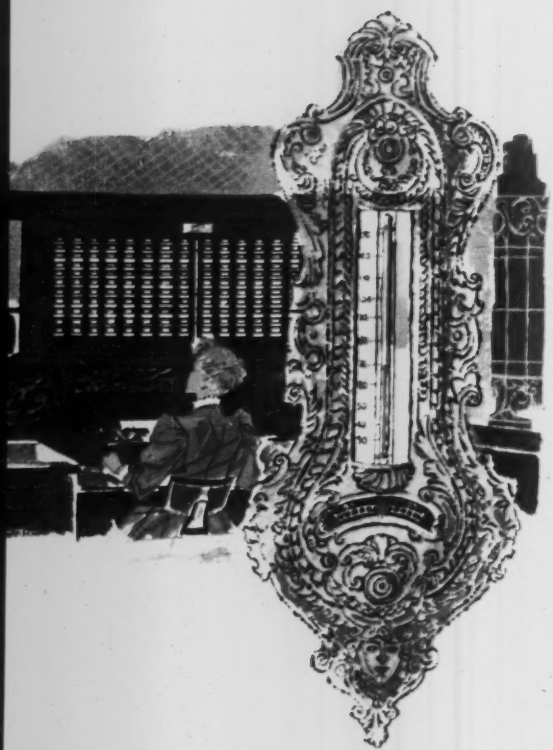
These are but a few examples of the ways in which modern pneumatic controls play a vital part in regulating the environment in which we live and work — helping to create made-to-order indoor climate for every purpose, controlling temperatures and humidities to a degree undreamed of when Professor Warren S. Johnson invented the first automatic temperature control system back in the 1880's.

Inventor at Work

Though he was probably unaware of the fact at the time, Professor Johnson became the founder of the automatic temperature control industry when he devised a practical way to eliminate the problem of classroom temperatures that seemed to zigzag forever between shiver and swelter.

His first attempt at control — the "annunciator" system — merely called the janitor's attention to overheating, or lack of heat, by ringing a bell in the furnace room. The janitor would then open or close the classroom dampers, as required.

But this land-based version of a ship's telegraph soon gave way to an all-electric method, utilizing a thermostat in each room that would open and close the dampers automatically. And so, the first system of automatic heat regulation was born.



The Electro-Pneumatic System

Intrigued with the possibilities of his long-awaited discoveries, Professor Johnson in 1883 left his post at Whitewater, Wisconsin, State College and came to Milwaukee to devote full time to refining and marketing the Johnson System.

His second major achievement, an electro-pneumatic control system, occurred almost at once. By successfully uniting the forces of *electricity*, for thermostat operation, and *compressed air*, for valve and damper operation, he developed a far more dependable and fully automatic control system. Finally he was ready to go out and revolutionize the comfort standards of the world. In 1885, he incorporated the business which today bears his name.

With branches established in Chicago, St. Louis, and New York, the Johnson thermostat on the wall soon became a familiar sight in the leading buildings of the day. Schools, prominent residences, and small business buildings were first to enjoy the comforts and economies of automatic control. They were followed closely by colleges, hospitals, public buildings, offices, stores, and industrial plants.

From Mikado to Czar

Acceptance grew, markets widened. The fame of automatic controls traveled fast and far. Before 1890, the city of Berlin, Prussia, had written a report about the efficiency of its Johnson System. Later, the palace of the Mikado in Japan was equipped with Johnson Control. The King of Spain and other European royalty became Johnson customers. A special installation was made in the Kremlin in Moscow!

Single Responsibility

Professor Johnson had the foresight to realize that the key to his success depended upon the *proper application* of his controls. Accordingly, he determined, from the outset, that his company should *never sell devices*, but should sell a *principle of control*. This meant that each system would have to be planned, manufactured, installed, and serviced *by Johnson* to meet the exact needs of the individual building.

Over the years, this policy of complete responsibility by a single specialized organization has insured owner satisfaction and saved untold millions of dollars for Johnson customers.

Carrying out this policy has also resulted in the closest possible working relationship between the Johnson organization and the nation's consulting engineers and architects, in a joint effort to provide ever better control of thermal conditions.

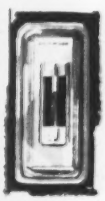
Many Johnson "Firsts"

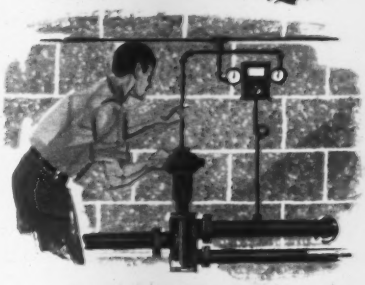
The history of the thermostat and the Johnson Service Company coincides with the period when other pioneers were busy introducing innovations in heating, cooling, and ventilating methods and in developing full-scale air conditioning. Working closely with the research staffs of these manufacturers, Johnson engineers were able to supply the most effective controls for every new development in basic equipment. This cooperation has continued and flourished to the present.

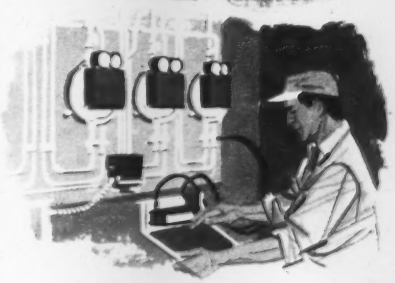
Over the years, the Johnson Service Company has been the source of a never-ending flow of new ideas, which have included virtually all of the key developments in the field of automatic temperature control!

By far the most important was the all-pneumatic control system, perfected in the 1890's and still the standard everywhere. Others include the all-metal thermostat, the famous *Dual* or day-night thermostat, the heating-cooling thermostat, summer-winter thermostats, the airstream thermostat, master-submaster thermostats, supersensitive gradual-acting thermostats, and powerful piston damper operators.

Another famous development was the Humidostat or humidity regulator. And, of course, the Comfostat, an exclusive Johnson instrument that controls room temperatures in relation to humidity conditions. The popular pneumatic control center, for centralized supervision and control of modern air-conditioning systems, also was first perfected by Johnson.







Uninterrupted Progress

As the concept of controlled environment gathered momentum, so did Johnson. Important "firsts" became routine jobs, as the industry looked to Johnson for the answers to new control problems. From the simple comfort needs of the buildings of the 80's and 90's, to the history-making demands of the first scientifically air-conditioned building, down to the most complex requirements of today's commercial and industrial buildings, Johnson has been the leader in the pneumatic temperature control field.

Today, wherever you go, you'll find the important buildings are equipped with Johnson Control. From the fabulous Fontainebleau Hotel to the mammoth Merchandise Mart to the famous UN Secretariat Building . . . in schools, hospitals, sprawling defense plants, research laboratories, vital military installations, shopping centers, in buildings of *every* size and type and in ships at sea . . . there are temperature and air-conditioning control systems by Johnson.

Johnson Today...and Tomorrow

To make certain that each installation performs up to expectations, Johnson backs its engineers with the most complete line of pneumatic temperature, humidity, and pressure control equipment in the industry.

To serve you most efficiently both before and *after* a sale, Johnson maintains the largest and most experienced field organization in the industry, with 107 completely staffed branch offices in the United States and Canada, plus full-time, factory-trained installation and service mechanics in over 200 other cities.

This is by no means the end of the story of the thermostat. For against this unmatched background of innovation, experience, and service, Johnson's never-ending search for new and better controls will inevitably lead to dramatic new ideas in the years ahead. As the day of completely air-conditioned cities approaches and as new and unprecedented demands for precision controls evolve, the forward-thinking Johnson organization will always be ready with the right answers.

The Johnson research and development staff and facilities have been expanded three times in the past four years. And final plans for the next major expansion are already underway! In the future then, as in the past, you can continue to look to Johnson for the world's finest controls!

Johnson Service Company, Milwaukee 1, Wisconsin. In Canada: Johnson Controls Ltd., Toronto 16, Ontario.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

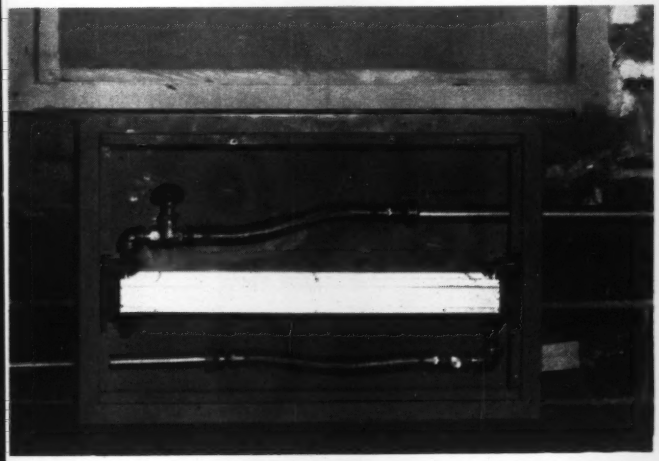
DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

AD 1073

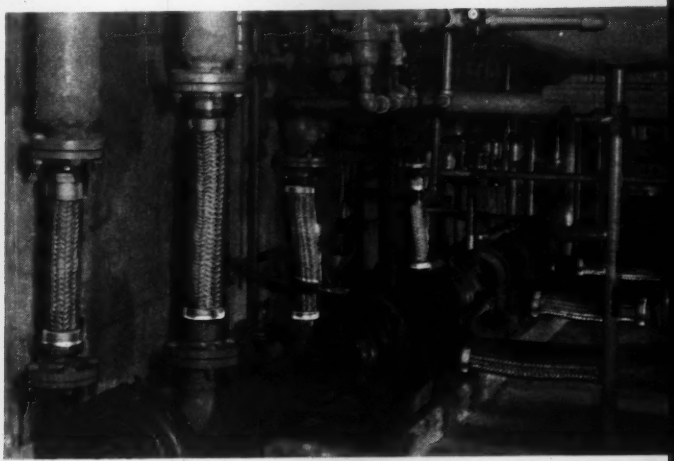
Printed in U.S.A.

APPLICATION HINTS:

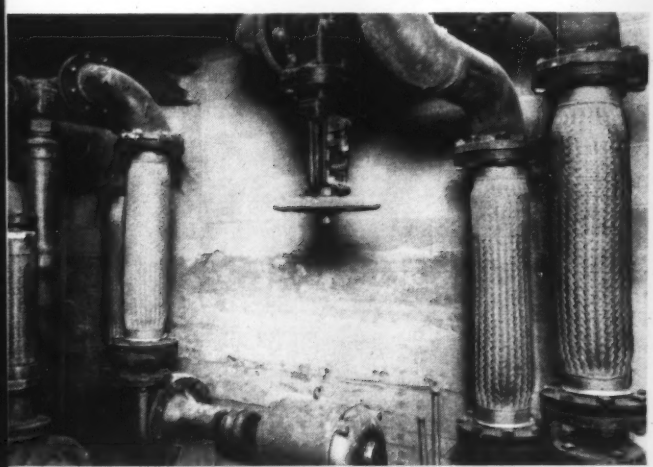
Ways to simplify construction and cut costs with Flexpipe



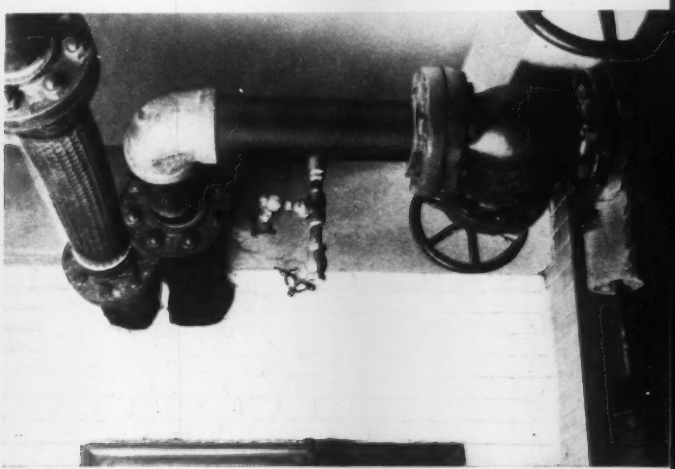
Cut total piping costs of heating systems. Flexpipe connectors handle offset and riser expansion—eliminate the need for extreme accuracy in roughing-in—eliminate time and cost of through-floor connections, hung ceilings and furred out walls. Piping can hug the wall, saving floor space. Flexpipes are used to simplify design and installation in both steam and hot water heating systems.



Save space, absorb vibration, cut installation time in air conditioning systems. In larger heating and cooling systems, Flexpipes take up movement caused by expansion and contraction in piping—absorb vibration from pumps—require less space—install easily in tight quarters—even when outlets do not line up—cut costs of using short lengths of pipe and elbows.



Handle expansion on long horizontal runs in big hot water jobs. Modern schools and institutions of multi-structure design involve long horizontal runs for hot water heating mains. Using Flexpipes to take up expansion and contraction in the mains can often eliminate the need for expansion bends—make possible smaller, more economical tunnels—simplify and speed installation—reduce maintenance. Flexpipes also dampen pump vibration and minimize transmission of noise along the heating mains.



Meet big, tough piping problems. Flexpipes have the flexibility and strength to handle many unusual and complex jobs. These are available in sizes through 16" I.D. in tin bronze, stainless steel or hot-dipped galvanized steel. In the installation above, Flexpipes helped solve some difficult problems in air conditioning a large office building. Flexpipes connect risers and branch pipes, handle movement up to 2 inches in the spring-mounted risers, and water pressures up to 400 psi at lower floors.

WHERE TO BUY: Leading plumbing and heating supply houses can provide you with information about Flexpipe in standard sizes. For the name and address of the distributor serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 60158

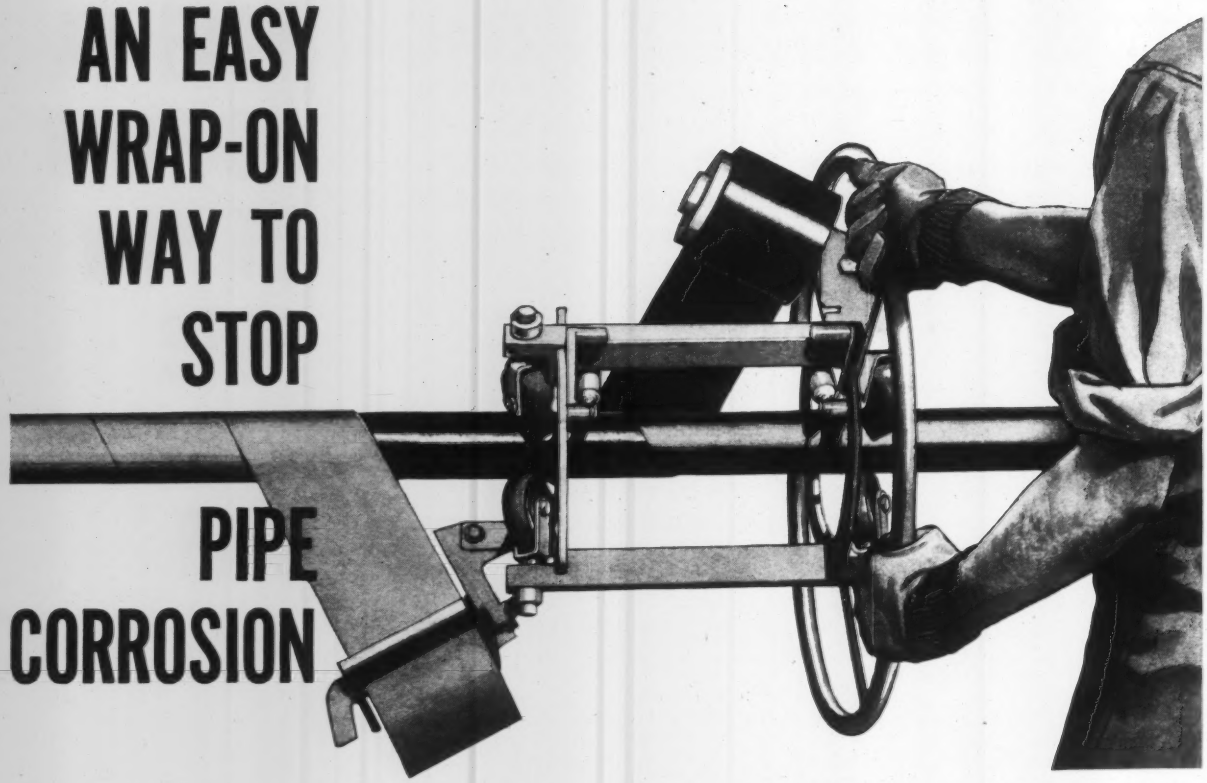
Flexpipe®

an

ANACONDA®

product

AN EASY WRAP-ON WAY TO STOP PIPE CORROSION



Chasekote*

Pressure-Sensitive Polyethylene Tape has an extra-heavy adhesive mass that clings to clean pipe on contact . . . makes a perfect, permanent bond that rustproofs, waterproofs and insulates pipe against all types of corrosion.

Chasewrap*

Protective Overwrap is a tough, wrinkle-free outerwrap that shields against abrasion, wear, and physical damage to the tape. Wraps simultaneously with the tape. Superior to rag and felt warps, yet far lower in cost.

**Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable*

The new CORR-PREV Pipe Coating Team comes in easy to handle tape form. It goes on pipe faster and lasts longer than corrosion-proof paints. It's cleaner and simpler to apply, too, than hot tar coats. And most important, this new CORR-PREV Team offers all the cost-cutting, pipe-saving advantages of *polyethylene* tape.

With CHASEWRAP Abrasion-Resistant Overwrap and Chasekote polyethylene tape, you get the easiest and best pipe protection at *lowest applied cost!* There's no heating, drying, clean-up or shut-down time. Each roll is factory-uniform in thickness and quality. And all coating materials — including rental of high-speed applicators — are available from one reliable source. Want samples? Specs? Prices? Write **CHASE & SONS, INC., Spruce St., North Quincy, Mass.**

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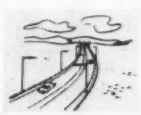

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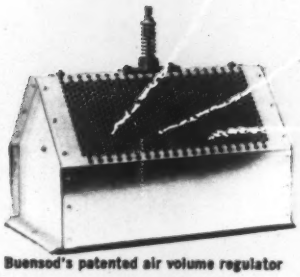
FOR YOUR ELECTRICAL INSULATION PROBLEMS SPECIFY CHASE FRICTION, PLASTIC, RUBBER, NEOPRENE AND BUTYL TAPES



Buensod's patented air volume regulator

dual-duct with avc

AVC . . . Automatic Volume Control
the patented, self-contained feature that sets Buensod Dual-Duct air mixing units head and shoulders above all others. Here's how it works: No matter what the variance in static pressures may be at either inlet or outlet valve, AVC maintains constant air volume ±5%. Therefore, the system cannot be thrown out of balance, regardless of daily changes in zone requirements. And remember, Buensod pioneered and developed Dual-Duct High Velocity Air Conditioning. Consider this advanced, year 'round method for your next installation . . . equally suitable in new or renovated structures. Send for Catalog DD-6.

BUENSOD

45 West 18th St.,
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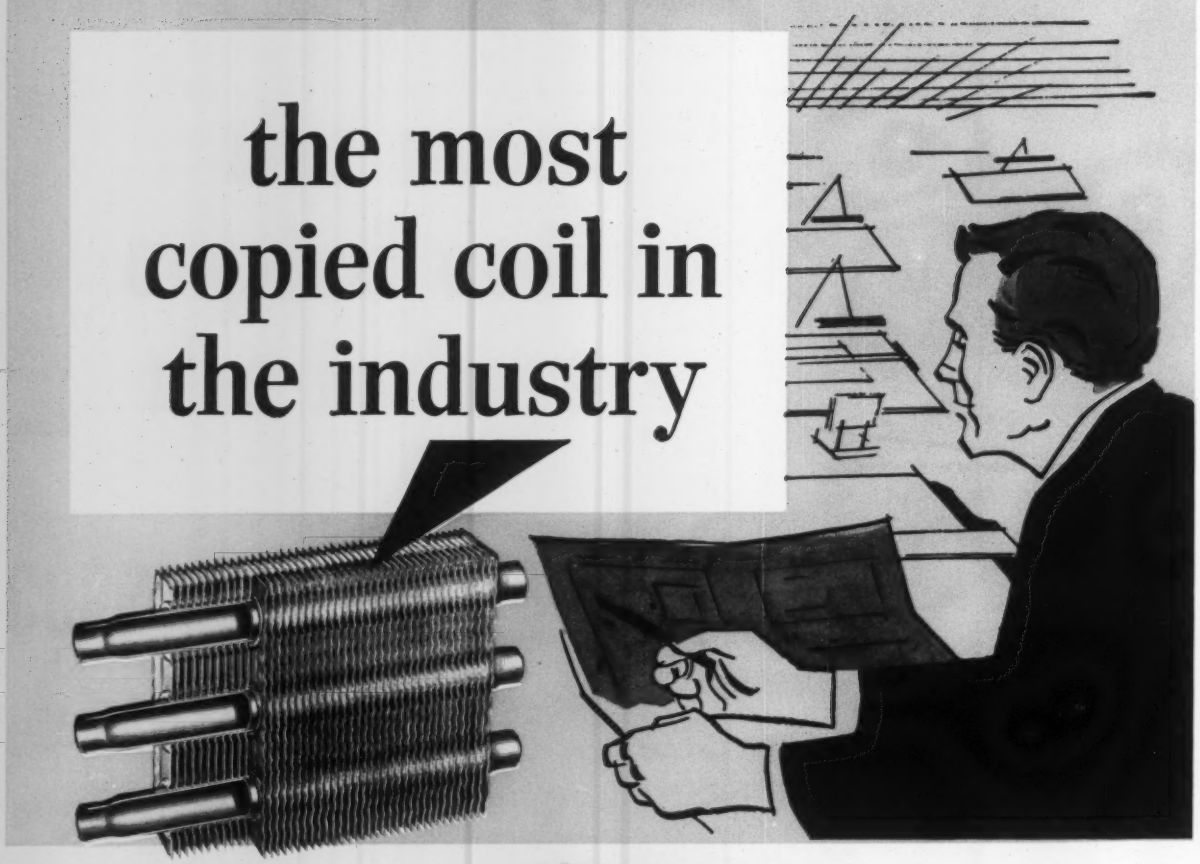
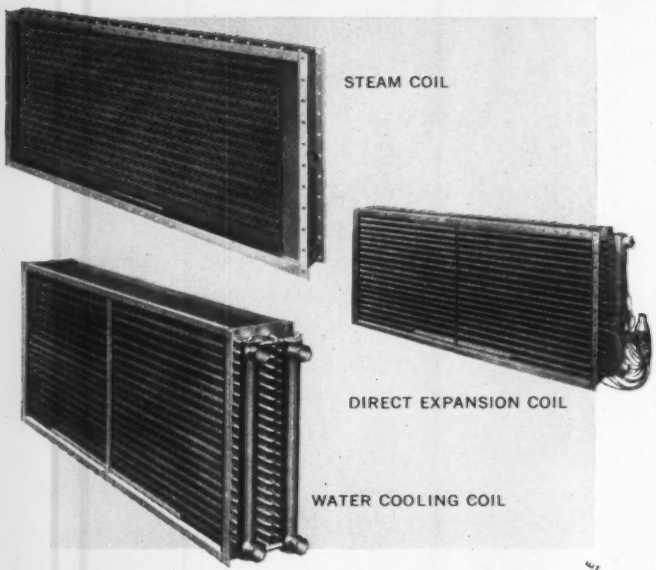
the most copied coil in the industry



Over the years, McQuay coils have stood the important test of time, and have justly earned their reputation for quality and performance. No wonder, then, that they are the most copied coils in the industry.

McQuay was the first to produce a permanent fin-to-tube bond without the use of solder. McQuay was first with Ripple-Fins, first to combine Ripple-Fins and staggered tube construction for maximum heat transfer, greater strength and rigidity. McQuay, also, was first to add full fin collars to its Ripple-Fin construction for accurate fin spacing and maximum heat transfer.

McQuay coils are available in the widest possible range of styles and capacities and are available for steam, hot water, chilled water, direct expansion, refrigerant condensing and all types of brine. For any coil requirement, call your McQuay representative, or write McQuay, Inc., 1601 Broadway Street N. E., Minneapolis 13, Minnesota.



Tube diameters 5/8"—1/2"—3/8"
One to 12 rows deep—One to 15 fins per inch

McQuay Means Quality

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

TO OUR BUSINESS FRIENDS

This is the age of breakthrough—the era of new frontiers.

And it is a time of challenge to American industry to meet the demands which call for fresh, new thinking.

Wolverine Tube is proud of the fact that it is pacing the industry. The research and development program, for example, has the tubing industry's most complete facilities devoted exclusively to probing into and improving the technology of tube manufacture.

From this continuing program have come improvements to existing products and the development of entirely new ones. And with these facilities, Wolverine's skilled technicians are extruding tube and shapes from such metals as zirconium, columbium, titanium, tantalum, molybdenum and others.

If you must meet the special requirements of today —and tomorrow—give us an opportunity to help. Just write.

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DIVISION OF
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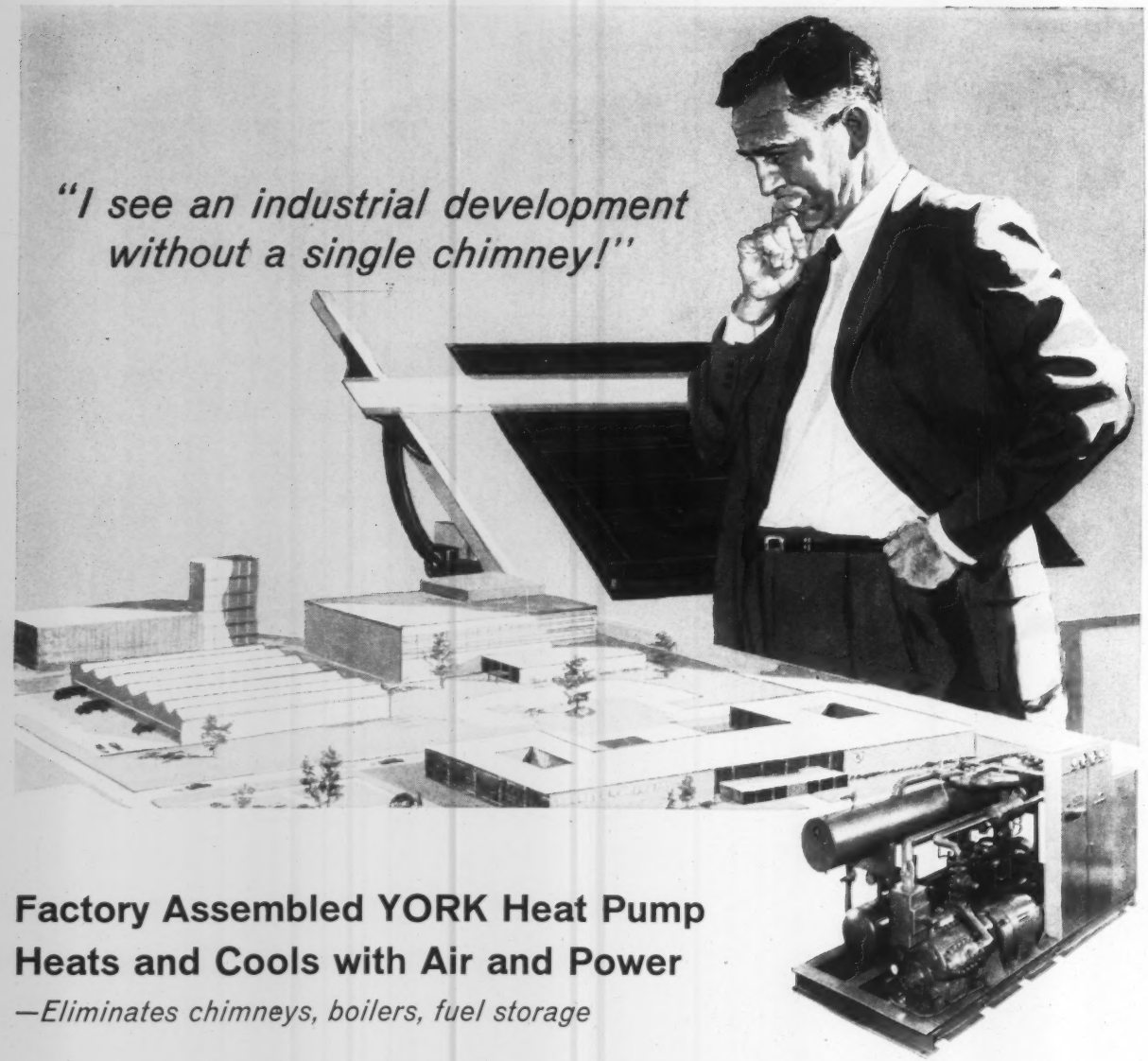
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes



Factory Assembled YORK Heat Pump Heats and Cools with Air and Power

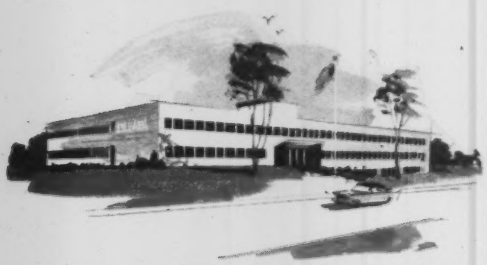
—Eliminates chimneys, boilers, fuel storage

EXCLUSIVE COMPOUND COMPRESSION—Patented multi-stage compression wrings heat from even – 10° F. air making York Heat Pumps practical in coldest climates. Compound compression delivers up to 67% more heat than single-stage system from same power.

REDUCES COSTS, SAVES SPACE—No unsightly chimney to build and maintain, no boilers to tend, no space-wasting fuel storage, no smoke and soot. Compact system can be located anywhere from basement to roof, or even in separate building.

NO SUPPLEMENTARY HEATING—Compound compression eliminates need for electric strip heating, reduces operating costs. York Heat Pumps can heat and cool simultaneously, or automatically switch from one to the other according to load.

SIMPLIFIED SELECTION AND INSTALLATION—Can be completely factory assembled to save design time and field labor. Units from 50 to 150 tons cooling and up to 1,200 MBH heating. Larger, field-assembled systems to meet your requirements.



Another YORK Trail Blazer Concept Proved in Action at *Sylvania Laboratory, Amherst, N. Y.*—A York Heat Pump provides all-weather air conditioning for this 85,000 sq. ft., 2½ story research and testing facility. System delivers 250 tons cooling and 2400 MBH heating to York perimeter fan-coil units.

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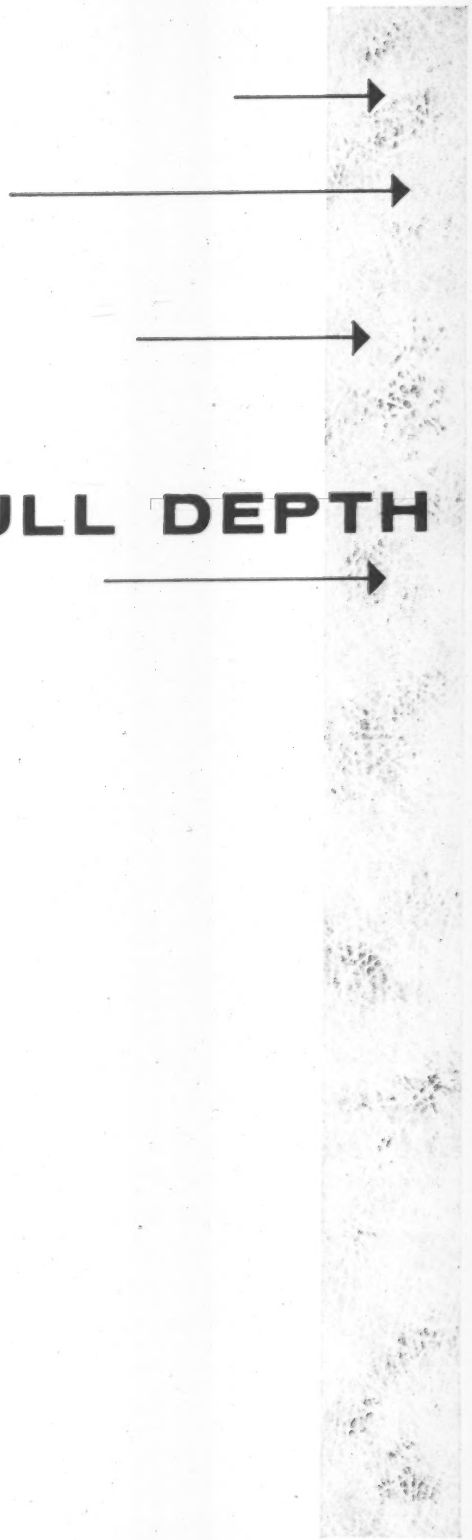
BORG-WARNER RESEARCH & ENGINEERING MAKE IT BETTER

Air Conditioning, Heating, Refrigeration and Ice-Making Equipment • Products for Home, Commercial and Industrial Applications



FULL DEPTH MAZE FILTRATION

A new achievement in FRAM Air Filters with specially engineered Celanese Fibers

Now comes a revolutionary new filter for home and commercial use! Tests prove Fram filters last longer and actually kill over 99% of trapped bacteria! Celanese fibers—engineered exclusively for Fram—minimize surface loading to provide full depth maze filtration. Result? Fram filters deliver 34% greater filter life and dirt retention.

16 leading manufacturers of heating and cooling equipment, firms such as RCA Whirlpool, Trane, Gibson, Coleman, York and Westinghouse Warm Air Furnace, have chosen Fram filters for their 1960 lines. Dependable, economical, these superior new filters are available in all sizes as well as rolls and pads. For full details, call or write: Fram Aire Corporation, a division of Fram Corporation, Providence 16, Rhode Island. Listed by Underwriters Laboratories, Inc.

Celanese Fibers Company, a division of Celanese Corporation of America, N. Y. 16. Celanese®

Celanese industrial fibers

ARCHITECT: Curtis E. Haley, Coral Gables, Fla.

CONSULTING ENGINEERS: J. E. Curley & Associates, Coral Gables, Fla.

THERMAL AGENT: A. C. Dean Co., Miami, Fla.

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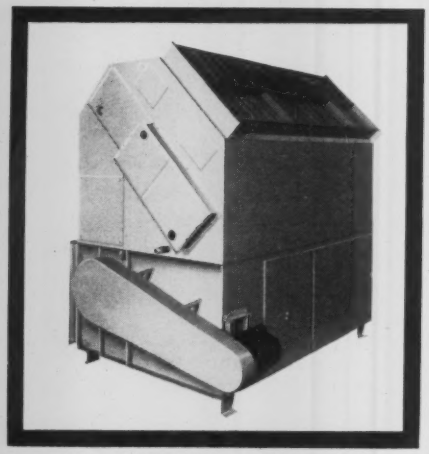

Vertical Multizone Unit

Thermal Units Air-Condition Huge Vocational School

The Lindsey Hopkins Vocational School in Miami, Florida, is believed to be the nation's largest and most successful adult vocational school with an enrollment of about 39,000. The building pictured above houses most of the classes which meet during the daytime and evening. Fifteen of Thermal Engineering's horizontal central plant type and multizone air conditioners maintain the comfort level in these busy classrooms.

From Presque Isle, Maine to Miami, Florida, and across the nation to the Pacific, Thermal Engineering's equipment is meeting the demand for year 'round comfort in all types of structures, under many varying climatic conditions. Its performance and quality assure architects and engineers that this equipment can be specified with confidence.

For finer air conditioning and ventilating equipment for every climate to fit all architectural requirements, you can specify Thermal. The Thermal line includes central plant and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils and air-cooled condensers. We will be glad to furnish you our complete catalog.

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Revolutionary Tool!

New Tee Turner cold draws reducing tees —no fittings necessary!

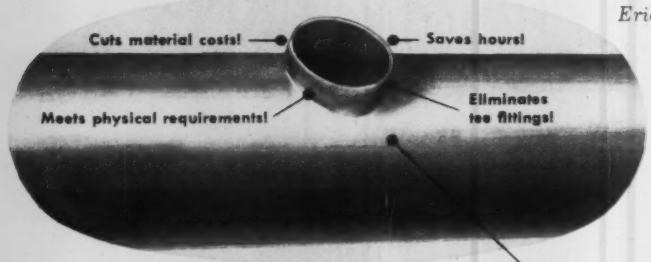
Here's the most revolutionary development in copper plumbing in a decade—a portable tool that "turns" reducing tee connections in K, L, M and DWV copper tubing (1¼" to 4") in five minutes.

The Tee Turner works equally well in the shop or on the job. It saves literally hundreds, even thousands of dollars on big jobs by (1) eliminating the need for reducing tee fittings, and (2) reducing the number of solder joints at each branch from 3 to 1. Cuts labor costs on tubing installations up to 75%!

The Tee Turner has been approved and specified for branching by consulting engineering firms all over the U.S. It has been used in the construction of schools, hospitals, motels, industrial plants, commercial buildings, and residences. In addition, it has proven ideal for remodeling and maintenance work in large plants and commercial buildings.

This tool is already being used by plumbers and mechanical contractors in Boston, Metropolitan New York, Newark, Miami, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, St. Louis, Dallas, Denver and Los Angeles.

Tee Turner tools are available for both water distribution and drainage systems. For complete information fast, write, wire, or mail coupon to *The Erie Tool Works, Dept. C-4, Erie, Pennsylvania.*



INFORMATION ON THIS REVOLUTIONARY TOOL!

THE ERIE TOOL WORKS, ERIE, PA., U.S.A.

Rush me literature with all the facts on the Tee Turner.

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C-4

Motors and Generators....that's our Business!

can do!

During your next planning pow-wow on a forthcoming project, consider this challenge (ME* Can Do!) from a tribe of "Injun-eers" who make motors and generators their only business . . . and who have been successfully conducting this business on product merit for nearly 50 years.

Feathers in our bonnet include some of the world's most honored projects and our scalp belt includes a multitude of the leading names in industry, but the Chiefs at ME* are more interested now in what ME* can do . . . for you!

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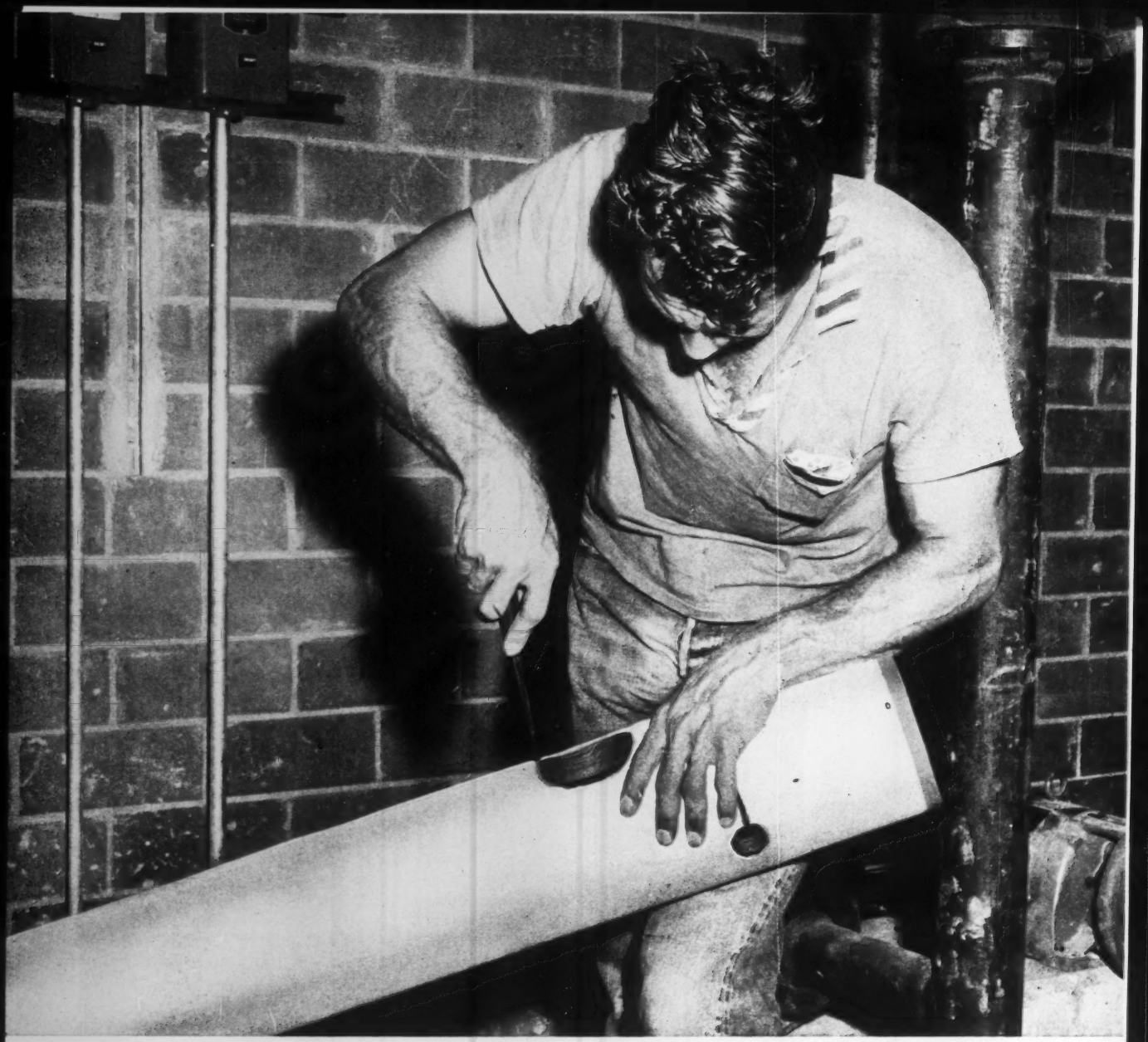

He's also cutting costs ... with G-B SNAP*ON® pipe insulation

When applying insulation around obstructions, try this "short-cut": simply use G-B SNAP*ON, the one-piece pipe insulation molded of fine glass fibers. In just a matter of seconds, G-B SNAP*ON can be "tailor-cut" to fit snugly, neatly around runouts, feeders, valves, fittings, etc. And unlike brittle, rigid-type insulation materials that crack and break, G-B SNAP*ON is highly resilient . . . less susceptible to damage during installation. You'll be amazed, too, at how fast you can insulate straight runs, because 3′ and 6′ sections of G-B SNAP*ON snap over pipe in one quick, simple motion.

Add to these advantages the permanence and superior thermal efficiency of G-B SNAP*ON, and you can readily understand why it is industry's No. 1 choice for heated or cold lines. It's available from local stocks . . . plain or with a variety of facings for hot or cold lines, indoors or out . . . in sizes from copper tubing to 36″ IPS.

FOR INFORMATION & PROMPT DELIVERY
SEE YOUR G-B SNAP*ON DISTRIBUTOR
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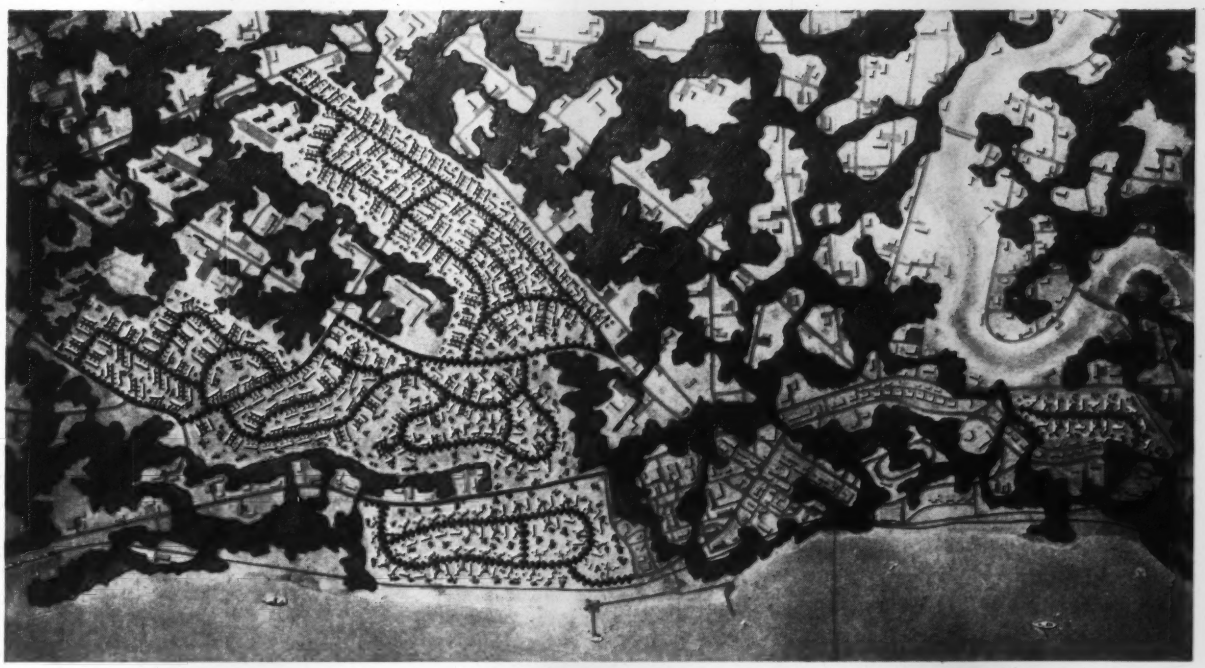
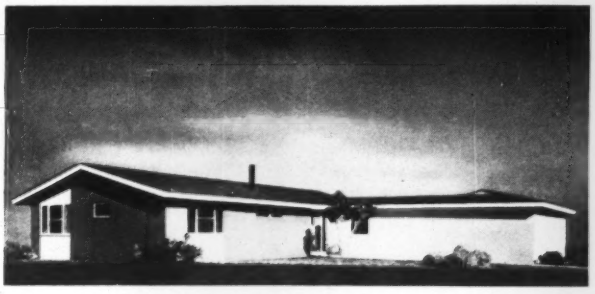
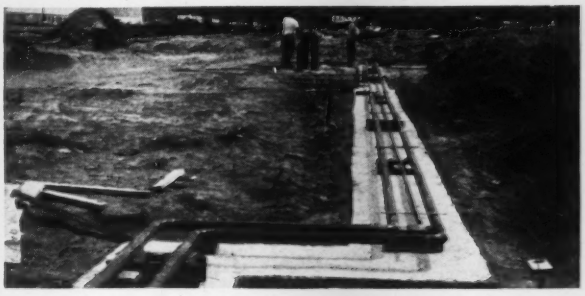
Couplings and fittings for plain and grooved end pipe







Architects-Engineers: Kelly & Gruzen, New York; George G. Shimamoto, AIA Associate • *General Contractor:* S. S. Silberblatt Incorporated, New York • *P&H Contractor:* Northeastern Construction Co., Plattsburgh • *Pipe Distributor:* E. J. Monroe Co., Plattsburgh

Steel pipe serves hot-water heating system of 1,685-unit Armed Services Housing Project

One of the largest housing developments in the country is the $27,500,000 project recently completed at Plattsburgh A.F.B., New York. Spread over 235 acres, the 396 buildings will accommodate Air Force officers, enlisted men, and their families.

A centralized hot-water heating system will keep the buildings comfortable even in the coldest of winters. And for the greatest of economies, the system was built with steel pipe—some 450 tons of Bethlehem Electric Resistance-Weld and Beth-Co-Weld steel pipe were used on the job.

For low original cost, low installation cost, and low maintenance, there's no substitute for steel pipe, the most economical and the most widely used general-purpose piping in America.

STEEL PIPE IS FIRST CHOICE
for lasting strength
economy
workability
insist on
STEEL PIPE MADE IN USA

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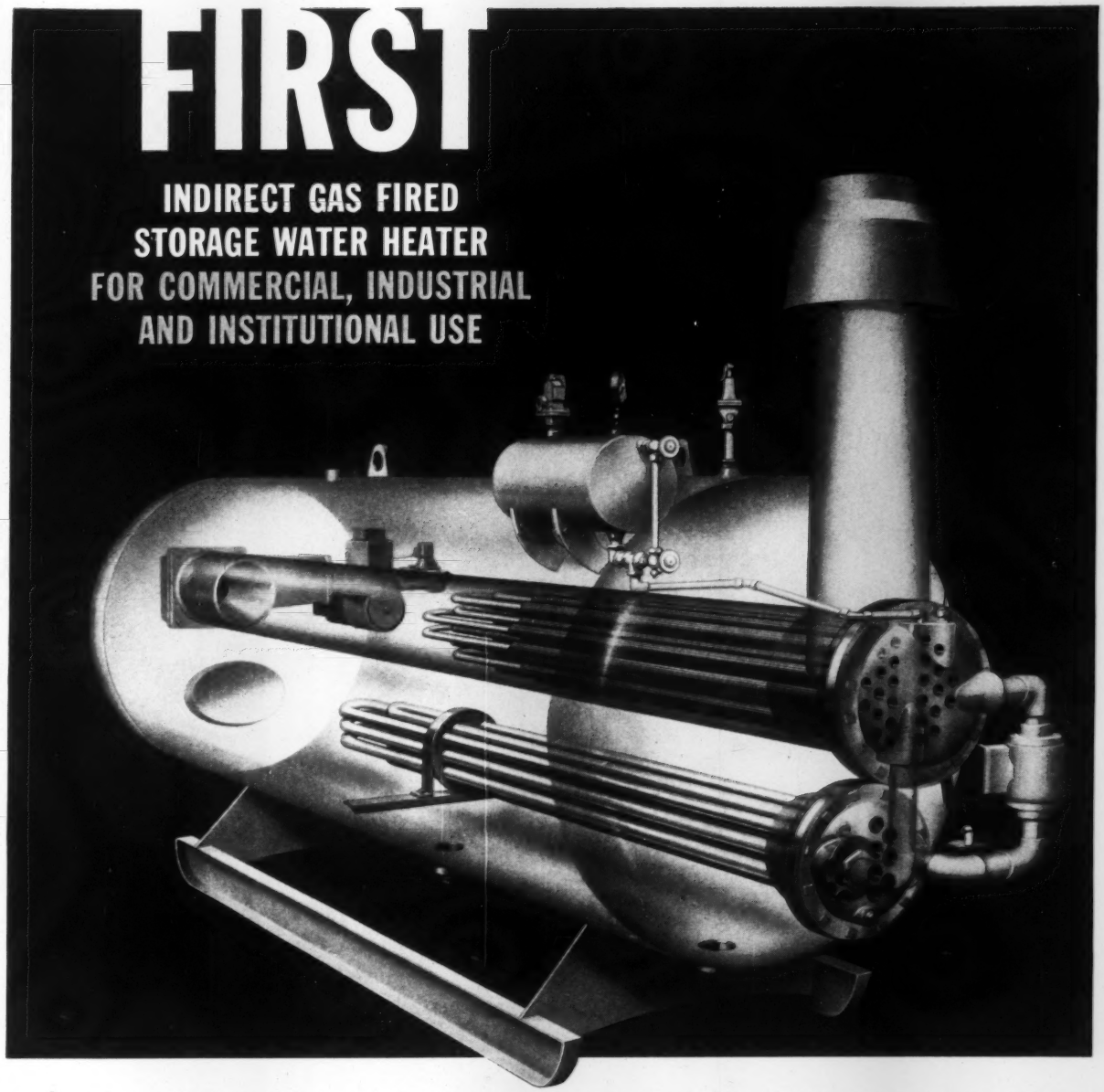


No scaling • No drop-off in rated efficiency • No fuel waste • No on-the-job assembly • No complicated maintenance • No limitations on placement • Fully automatic • Copper heating surface

P-K SCALEFREE 230* is a unique rugged unit backed by P-K's 80 years of experience in building and designing quality water heating equipment. It heats water through hot intermediate distilled water. Transfer occurs below the temperature at which minerals that cause scaling precipitate. Efficiency remains unimpaired throughout service life. Linings of pre-Krete or copper are available to keep the unit free of rust and corrosion regardless of water conditions.

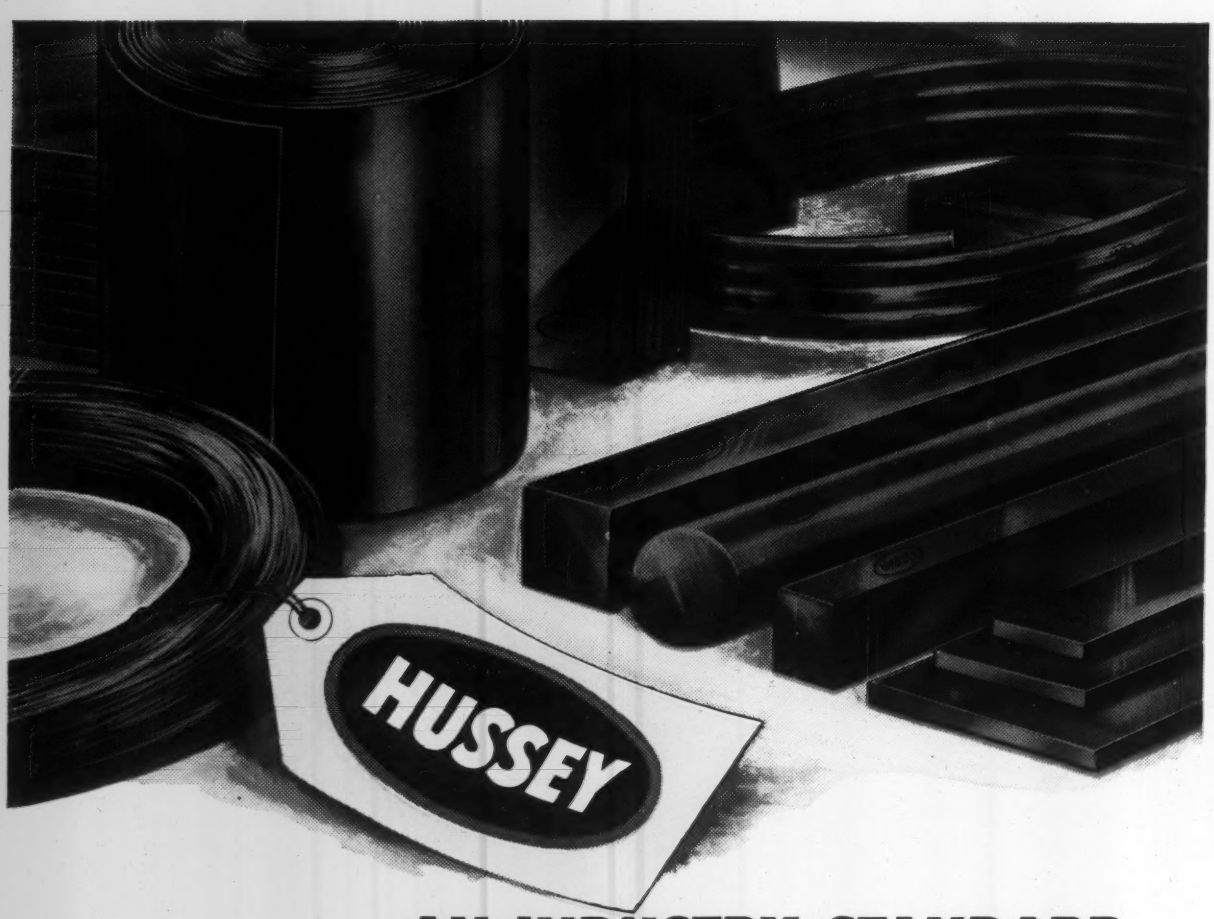
SCALEFREE 230 features a new P-K gas burner. It operates at maximum practical efficiency. Yet it gives almost noiseless service—does not rumble or boom on startup. This permits location almost anywhere in office buildings, institutions, schools, motels, etc.

SCALEFREE 230 is a complete fully automatic package that can be quickly set in place, hooked up and checked out. It is available in more than 100 storage and recovery combinations. Storage capacities range from 250 to 4000 gallons. Recovery sections range from 390,000 to 2,215,000 Btu. Write for catalog with full information.

*Patent pending

Patterson Kelley

102 Morgan Ave., East Stroudsburg, Pa.



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Hussey's experience in copper goes back to 1848. Since that time it has steadily built a reputation for producing the finest quality copper available. And, because Hussey Copper is mined, smelted, refined and rolled by a single source, quality is easier to control and maintain. Whatever your need for copper, make sure you use the best—specify Hussey.

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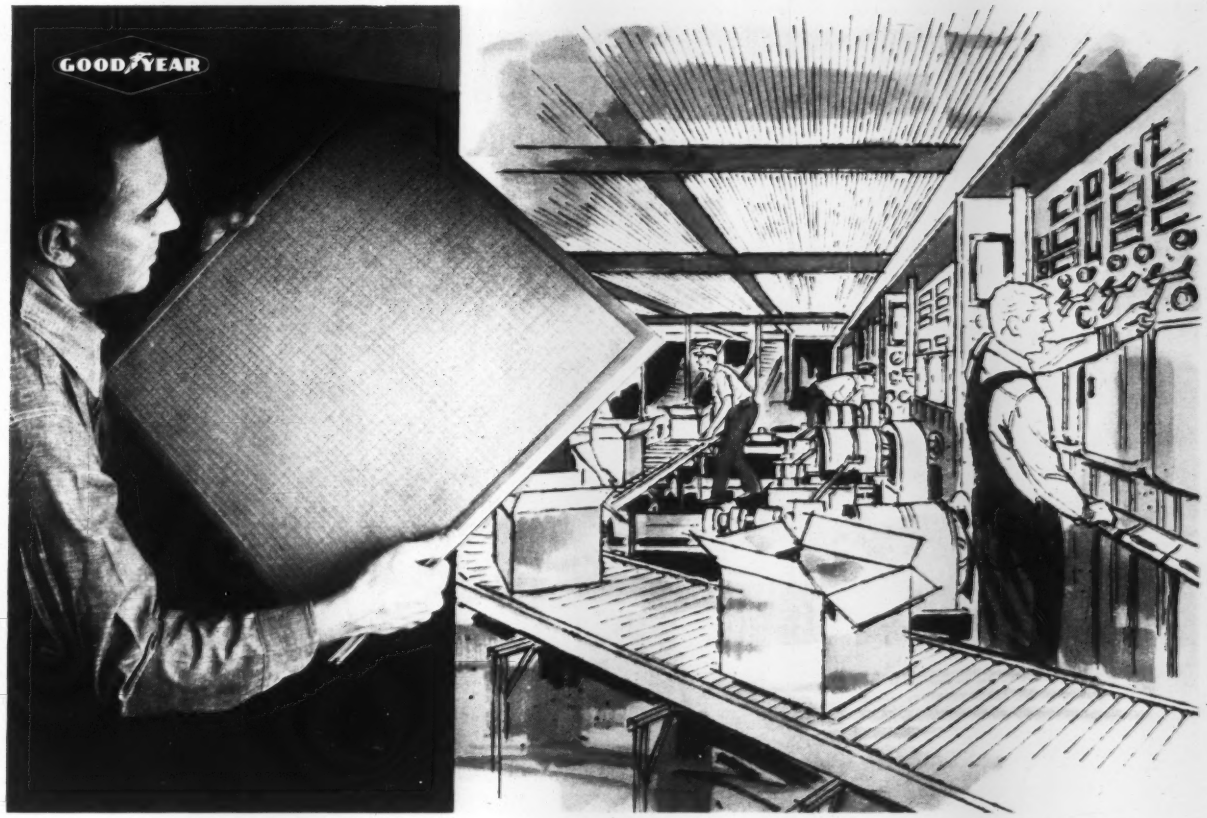
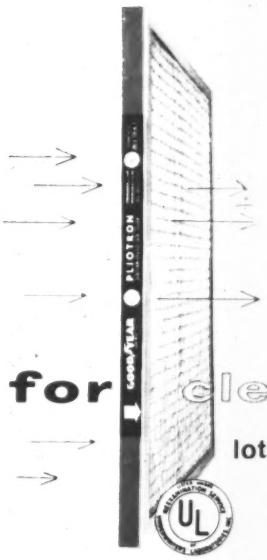
MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY



How to make filter-failures your road to success



It's no problem to find unhappy filter-users these days. A lot of the air filters on the market today just aren't equal to the demands of modern blower-type heating and air-conditioning systems.

That's where you and PLIOTRON super-filters come in. For you install PLIOTRON with the knowledge that it will stop fine dirt particles ordinary filters only sift—up to *five times* as many of them, in fact.

Customers are bound to be happy with that kind of improved filter-power. Result: you eliminate a lot of complaints and profit-eating call-backs.

One PLIOTRON installation leads to others. Users want more of the same extra-efficient, trouble-free filtering in *all* their air-conditioners and/or heating units.

Word gets around, too, that you are the man who clears up filter-failure problems. And that's the kind of business-boosting advertising that you can't buy—for love or money.

Best of all, you've got a complete range of PLIOTRON super-filters to meet every need. There's the improved PLIOTRON HD Filter for critical installations calling for maximum filter-power. And the PLIOTRON CR handles most routine commercial installations. More details? Just write Goodyear, P.O. Box 52, Akron, Ohio.

for cleaner air everywhere- PLIOTRON

lots of good things come from

GOODYEAR

PLIOTRON—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

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FAST LOCAL SERVICE

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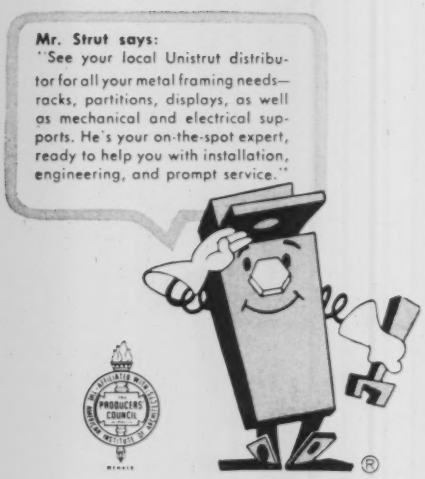
Mr. Strut says:
"See your local Unistrut distributor for all your metal framing needs—racks, partitions, displays, as well as mechanical and electrical supports. He's your on-the-spot expert, ready to help you with installation, engineering, and prompt service."
PRODUCERS COUNCIL

With the UNISTRUT system of mechanical and electrical supports you're never out on a limb for the right fitting. Unistrut engineers, with more years of experience behind them, have developed a line of fittings and accessories that is unmatched for its completeness and versatility. No matter what kind of on-the-job problems you run into, the UNISTRUT system provides matched framing channels and fittings to handle it.

No makeshifts, no costly delays. Your Unistrut distributor maintains complete stocks at all times to give you on-the-spot service. For all your mechanical and electrical supports, stick to UNISTRUT, the original—and still the world's most versatile —adjustable metal framing system.

You can't make a mistake with UNISTRUT framing...it's 100% adjustable on the job. And there's a UNISTRUT fitting for every need. Call or write for catalog.

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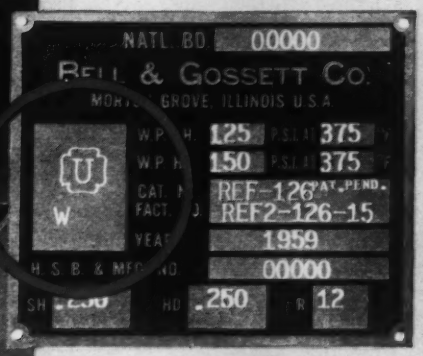
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For heating or cooling liquids or gases, all B&G Heat Exchangers are built to A.S.M.E. Code requirements

B&G Heat Exchangers are not only engineered to top efficiency but are constructed to the uncompromising standards of quality and safety demanded by the A.S.M.E. Code.

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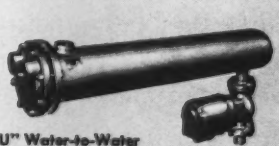

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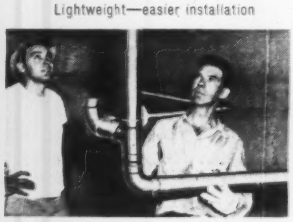

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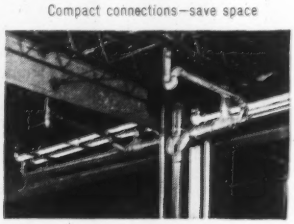

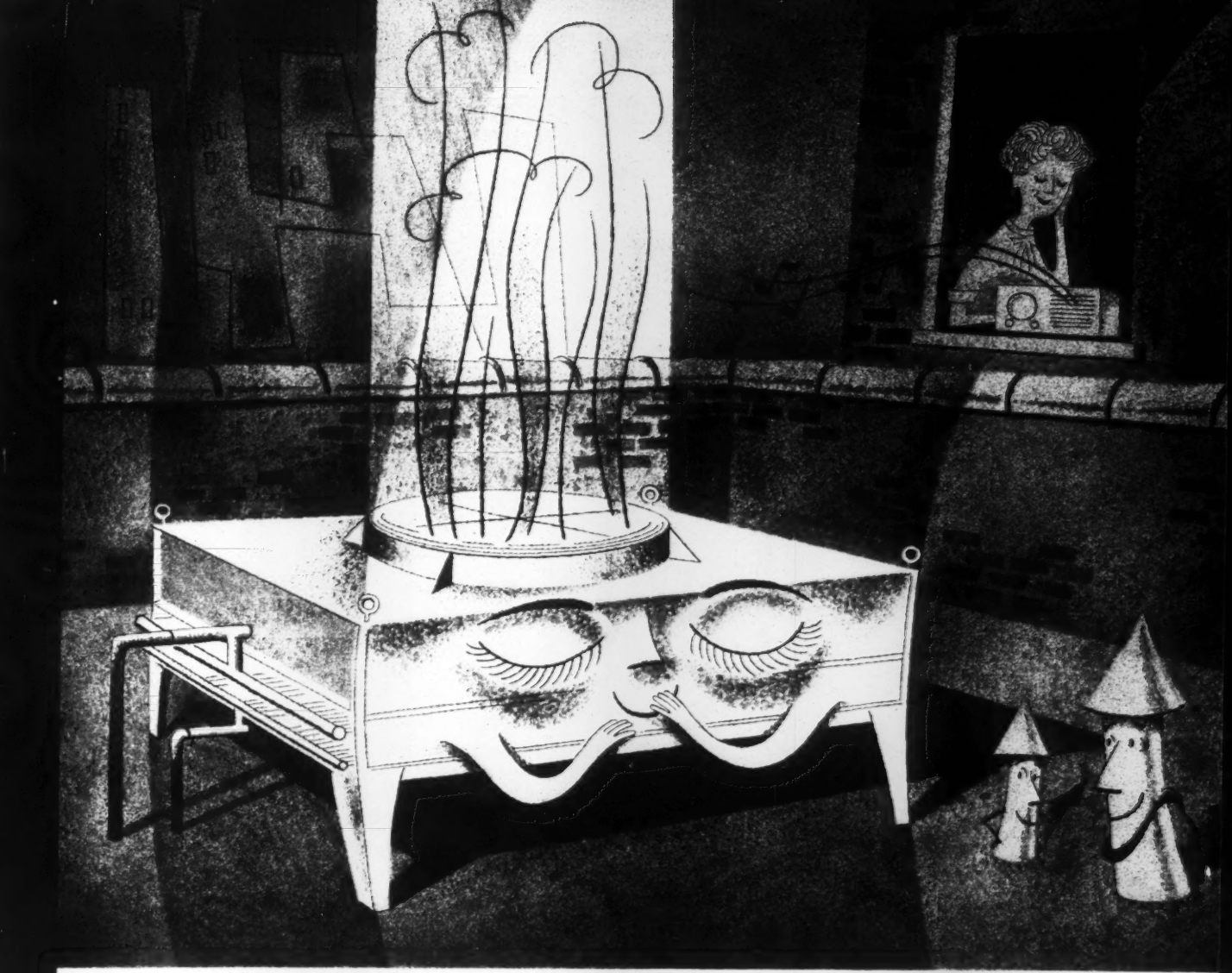

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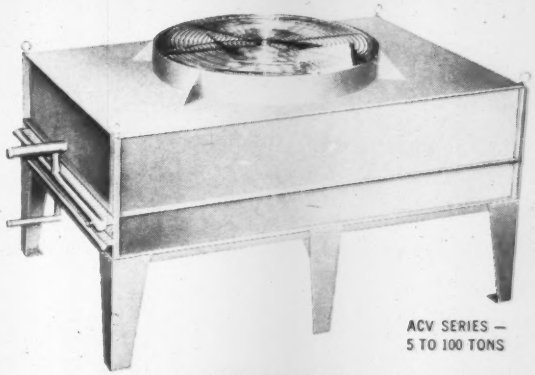

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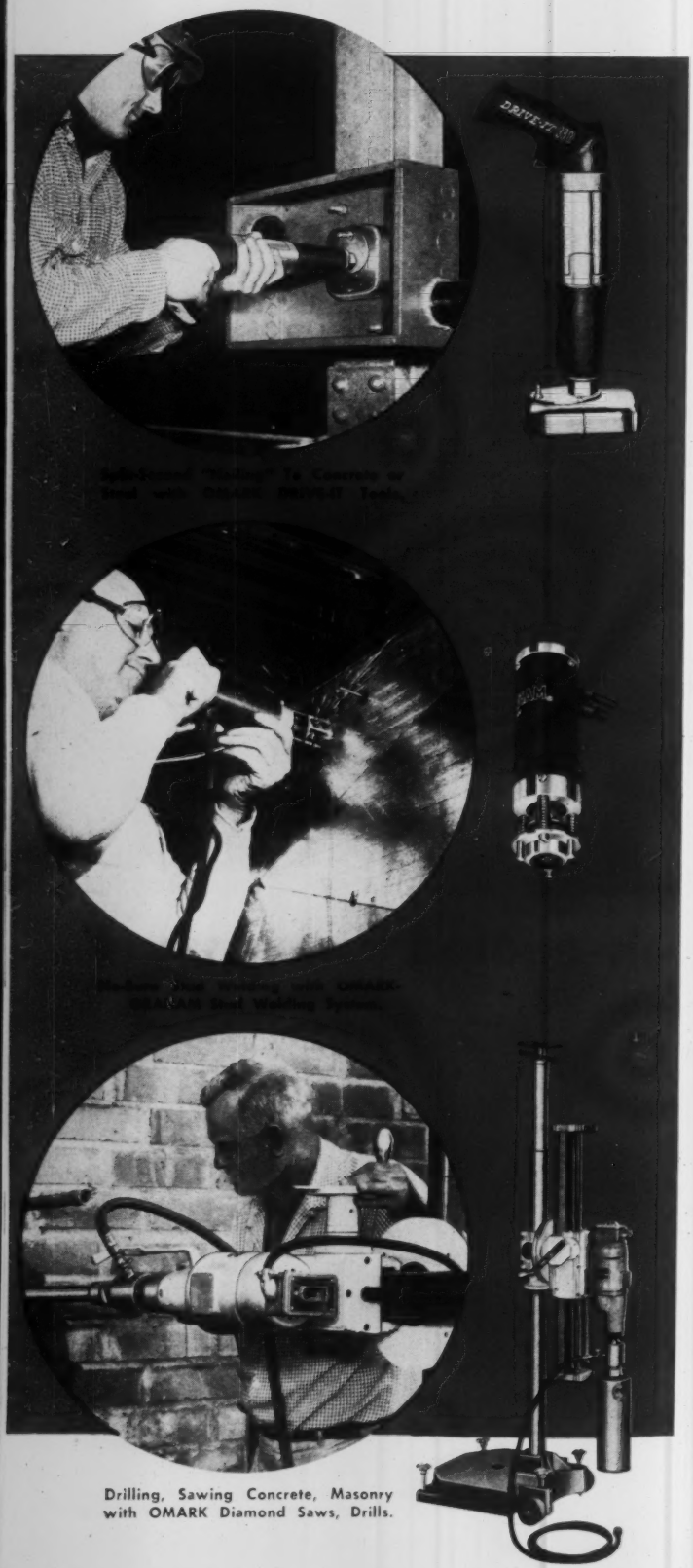

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"open for discussion"

We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

Article Gives Excellent Comparison of Marine and Land Air Conditioning

THE ARTICLE, *How Shipboard Air Conditioning Compares to Land Installations*, by John W. Markert (March), is an excellent presentation of the principal design criteria of marine air conditioning and their comparison to land installations. His reference to passenger liners as "floating hotels" is most appropriate. I might add that they are, as a rule, "floating luxurious hotels."

The overall length of practically all of the recent passenger liners constructed in this country since World War II, including those which have been completely reconverted, exceeds in height practically all of the hotels throughout the world. In fact, some would tower even beyond the 47-story Waldorf-Astoria, New York's skyscraper hotel.

It should also be noted that some of the innovations for land air conditioning originated on ships. In fact, high velocity systems are well advanced over land installations and it would be not at all surprising to see these advanced systems making an appearance in buildings within the next few years.

S. W. BROWN
Consulting Engineer

Close Approach to WB Requires Very Clean Cooling Tower, Coil

WITH REFERENCE to the HPAC Engineering Data File, *Evaporative Cooling — When and How to Use It* (March), I note that it is assumed that a dry extended surface coil can reduce the temperature of the supply air from outdoors to within 8 F of the outdoor wet bulb temperature. To achieve this close an approach to wet bulb temperature requires that the cooling tower and the coil must be kept very clean. It also requires that at least an eight-row coil be used. Some installations using six-row coils cannot achieve this close an approach even though the system is brand new and there is no sludge deposit on the inside of the coil, dirt deposit on the outside of the coil, or poor distribution of water in the cooling tower.

I have found that where the cooling tower-dry coil combination is used, it is safer to design on a 15 F approach to the wet bulb, that is, the air leaving the dry coil is within 15 F of the wet bulb temperature. A further comment is that the 8 F approach requires a counterflow in the dry coil.

S. F. DUNCAN
Director of Research
Farr Co.

Outlet Arrangement Is Important To Comfort, Heat Conservation

K. E. ROBINSON'S article, *Plant's Revamped Supply Air System Gives Workers Year 'Round Comfort* (January), is very interesting and informative. It shows what can be done with many existing installations to make them effective systems.

In particular, it should be noted that the system was not effective until the supply air was delivered to the worker through low level outlets, and until they were arranged to permit the air to be directed up or down, as desired by the workers for warm or cool weather conditions. This arrangement is extremely important, not only from the comfort standpoint, but also from the standpoint of heat conservation.

Mr. Robinson indicates that by directing the supply air upward in the winter it could be delivered to the space at 68 F in lieu of 80 F, as previously required. Obviously, internal heat is available to permit this, as he mentions.

In terms of steam, the 12 F reduction in temperature, for the 750,000 cfm of plant supply air, amounts to approximately 10,300 lb per hr. At a cost of $0.75 per 1000 lb, this would amount to $7.70 per hr, or a savings of $34,000 for a six-month heating season or $24,000 for 26 five-day weeks. This will pay for a lot of duct alterations. Most of us should see what we can do to save by this method.

I recently observed two similar systems operating

at discharge temperatures of 48 and 57 F, respectively, with the spaces at a comfortable 75 and 70 F with the outside temperature at about 28 F. It is possible to have vastly improved working conditions and economy, too. (Note that the space temperature in Mr. Robinson's article was kept within 1 or 2 F of the outside air in warm weather.)

JOHN H. CLARKE
Engineering Design Supervisor
Air Conditioning and Power
Visking Co.
Div. of Union Carbide Corp.

Investigations Support Stands Taken In Refrigerant Piping Design Article

HERMAN VETTER'S *What Are We Paying for High Velocity In Refrigerant Piping Design, Operation?* (January) is a timely and logical discussion on an important phase of engineering theory and practice.

The author, in his discussion of high velocities in piping systems and high speed compressors, stays well within the bounds of good engineering economics — the practical, grass roots of the matter. He has pointed out quite clearly the fallacy of thinking only in terms of first cost without giving appropriate consideration to the important matter of operating costs. My personal experience, extending over many years and including many investigations devoted to finding the cause of high power consumption and loss of capacity, fully substantiates the position taken by Mr. Vetter.

Unfortunately, a large segment of the "best minds" in industry have been largely brain-washed by the theme song, "keep capital investment down." Because of this, they fail to take into account the question of operating costs—a most important factor in any business operation.

Quite obviously, first costs are important and should be given proper place in the general scheme of things. Interest on investment of capital employed in new construction should be essayed as completely as other components that make up the sum total of overhead or fixed charges.

We might, however, make a curious commentary on one who will not accept the facts that prove the advantages in operating costs that are possible by following good engineering design even though the first cost may be a few thousand dollars above the low bid offered by the fair haired boys whose primary interest is sales, with economy of operation second.

When a businessman is shown, as is often true, that the extra investment over and above the low bidder can be recovered within two to three years or less, he stands in his own light when he won't be convinced.

The following case histories are recorded here as evidence in support of Mr. Vetter's position:

Case No. 1. The size of the suction line between an ice tank and the ammonia compressor was 3 in. The president of the ice and cold storage plant (which represented an investment of several hundred thousand dollars) complained to the chief engineer that the cost of power to operate the ice department was out of line.

"Correct," replied the engineer, "but you refuse to let me spend money to increase the overloaded suction line connecting the tank to the compressor. Therefore I can do but little in other ways to reduce power consumption."

The chief engineer had measured, by means of calibrated gages, the pressure loss between the suction header on the tank coils and suction inlet to the compressor. It was found to be never less than 5 psi. During maximum output it often amounted to 6 psi.

This plant was favorably located with reference to both a wholesale market and refrigerator car icing. Therefore it had a most favorable annual load factor. The plant was well operated. A daily operating log was a must. The total current consumption for each day was recorded, as was the ice pulled and the current consumption per ton of ice produced.

In addition to the freezing tank, the 3 in. suction line also carried the suction from a 12 × 14 ft daily ice storage room. A 4 in. line replaced the 3 in. line that had been installed when the ice tank was erected many years earlier. The chief engineer was able to eliminate two right angle elbows and to reduce the overall length of the line 8 ft when installing the new line.

To make a long story short, the pressure loss of the new line between freezing tank and compressor was reduced to 1 psi, the current consumed per ton

Asks Correction in Piping Article

AN ERROR in my article, *New Formulas Aid Computer Solution of Piping Design Stress Problems* (January), has been brought to my attention. On page 197, in the second paragraph of the second column, I stated that "*Ys*, *Yu*, and *Ye* are angular displacement at the anchor (in radians)." Actually, the units are inches of arc divided by radius in feet. These are very awkward units and I regret using them. I did not notice this error when I solved the Hovgaard equations because the angular displacement is given there as zero. Therefore, using improper units made no error in the example.

THEODORE E. BRIDGE
Piping Design Consultant

of ice pulled was reduced from an average of 75 kwhr to 62 kwhr, and the output was increased from 50 to 55 tons daily.

The average cost for electric current at this plant was 1¼ cents per kwhr. In one case, the cost per ton for power was 93¾ cents, while in the latter case it was reduced to 75 cents — a reduction of nearly 19 cents per ton.

In the case of the original suction line, the size selected was purely by rule of thumb. No one in the organization at that time had known much about pressure loss or gas velocity.

Case No. 2. An operation that included a 50 ton ice plant, an ice cream plant, and a dairy plant had a connected motor load of slightly over 600 hp. Condensing water for the ice plant and ice cream plant was pumped from a nearby stream which, during most of the summer, was somewhat sluggish. Often the temperature of this stream exceeded 80 F since it was largely exposed to direct sun rays.

As originally installed, the condensing water was supplied by one motor driven pump. Some time later a second pumping unit of the same capacity and head was installed. However, this second unit did not help much, as the condensing pressure continued to remain 225 to 230 psig.

The dairy plant was connected to an evaporative condenser and was therefore not subjected to the high condensing pressure as prevailed on the ice and ice cream phases of the plant operations. My investigation to determine the reason for high power costs disclosed the following facts:

1) Both the original and the new pump were connected to the same suction which was hardly large enough for one pump.

2) The suction line measured 150 ft overall, including a vertical section of 13 ft.

3) The discharge line as originally installed was made to serve both pumps.

4) The foot valve installed with the original pump was very old and not long for this world. It had a net free opening of only 75 percent of the suction pipe.

The problem was solved by installing a second suction line which was made ½ in. larger in diameter than the opening in the pump casing. A new foot valve was provided for the original suction line, as was also a foot valve for the new line. In each case, the opening into the foot valves was made ½ in. larger in diameter than the pipe size. The foot valves were connected to their respective suction lines with a reducing transition piece.

The discharge pipe on the original pump was rearranged to supply one condenser while the discharge from the new pump handled the other. By this arrangement each condenser received an ample supply of water. The net result of the changes made was a saving of 18 kwhr per ton of ice made. With electric power costing 1.4 cents per kwhr, this represented a reduction of 25 cents per ton.

Why was one line used for two pumps? First cost. I could, if space permitted, cite other instances of high velocity *vs* net earnings and high power costs since I have investigated many and know something of the losses that have resulted from "what price glory and high velocity."

We should not lose sight of the very fundemental fact that the capacity of a refrigerating compressor depends upon the actual weight of gas handled by a compressor per unit of time. If high velocities in pipelines and through suction valves in the compressor keeps "the weight down," then the number of kilowatt hours required to produce a net ton of refrigeration will be far above normal.

Competitive markets have been responsible for the development and growth of the high speed compressor. However, I do not believe that the high speed compressor is the greatest gift to mankind.

Mr. Vetter is to be congratulated on a job well done.

C. T. Baker
Consulting Engineer

The author's reply—I thank Mr. Baker for his kind remarks and concur with his comment that "unfortunately, a large section of the 'best minds' in industry have been brainwashed by the theme song, 'keep capital investment down.'"

Strangely enough, I have had cases in which the capital investment was less for the proper design than for the so-called modern design. In Case No. 1 in my article, the change in the piping was made and the capacity was increased 100 percent without adding additional compressors. In this plant an order had been placed for two compressors and this order was cancelled as we were able to increase the capacity with the existing compressors. The speed of the existing compressors was not changed in order to gain this additional capacity.

Herman Vetter
Vetter Engineering Co.
Industrial Consulting Engineers

Instead of Fighting Gravity Why Not Put It to Work?

In his excellent article, *Unique Built-Up System Serves Exacting Temperature, Humidity Demands* (February 1959), Ivan F. Norcross describes a method of ventilating and cooling IBM machine rooms.

A wit once remarked that a difference of opinion makes horse races. Also, it sometimes contributes to different thinking on the part of engineers. The object of the following remarks is not to be contentious, but to open a discussion so that, jointly, we may come to

an understanding of the IBM machine room problem and its method of handling.

As the article pointed out, the stipulations laid down by the IBM people are not arbitrary, but are the results of practical experience with their own equipment. Hence, the stipulation for humidity is based on the very definite knowledge of how much the stretch of the recording tape will upset the accurate performance of the machine or group of machines. Such a specification is highly important and can only be regarded as a controlling factor.

Based on a rather extended experience of industrial ventilation which started when gravity ventilation was about the only thing available, one cannot help but remember that early training and the effect of gravity air flow. Specifically, the hot air being discharged from the machines has a normal tendency to rise because it is being pressed upward by the weight of the cooler air surrounding the heated area or injected by the air conditioning and cooling system. In our humble opinion, the introduction of cooling air above the hot spots with a downward discharge and a perimeter exhaust system at the floor line is literally "bucking city hall" and "fighting gravity."

We have had some experience in IBM work, and have found that the introduction of cool air at the floor line with sufficient moisture content so that the heat generated by the machines (which does not add moisture) will transform that moisture laden air into the 50 percent relative humidity required by the tape systems. The effluent air rising above, and from the immediate vicinity of, the heat generating IBM equipment wants to go up and out. Therefore, in our opinion, this tendency should not be thwarted.

There is an additional advantage from the minimizing of turbulence in the room to be achieved by this means. In this manner, the heat of the machines is not disbursed by means of an excessive admixture of rather larger quantities of cooling air. Instead, the cooling air is released near the floor and in the vicinity of occupancy so that its cooling effect can be most appreciated both by the personnel and the machines.

In one typical installation, we had an illuminated ceiling above the equipment. This ceiling, fortunately, was of the open egg crate type. Thus, it was extremely easy to pick up the rising warm air above the egg crate ceiling and, at the same time, remove the heat of the lamps.

As in all engineering problems and their solutions, some assumptions have to be made. These are usually based on either experience or just plain horse sense. The case in point is no exception.

Since we are mostly interested in maintaining a comfort zone up to the 6 ft level, we usually, though not always, assume that 30 percent of the heat of the lights and 30 percent of the radiant heat of the machines is absorbed in this area. The balance of the heat is above the 6 ft level. Obviously, the air at the 6 ft level will be at design room conditions and the temperature will go up and the relative humidity will drop as the air goes up to the ceiling. When the air arrives in the plenum area, it may be up to 80 or 90 F.

Now, with reference to the very elementary Carnot cycle, any compression and expansion system which approaches the 100 percent coefficient of the cycle will return an improved performance. Manifestly, the higher the return air temperature to the heat exchanger in the air cooling system, the higher the temperature difference across the heat exchanger surface, the higher the efficiency of that surface, and the greater the economy of the system as a whole.

In the early days of refrigeration and into the present day, it is not unusual to speak of the requirements of air conditioning on the basis of 1 ton of cooling capacity per 1 nominal hp. Following the principles outlined, we have been successful in installing an IBM air handling and conditioning system which produces 1.25 tons of cooling per nominal horsepower of input.

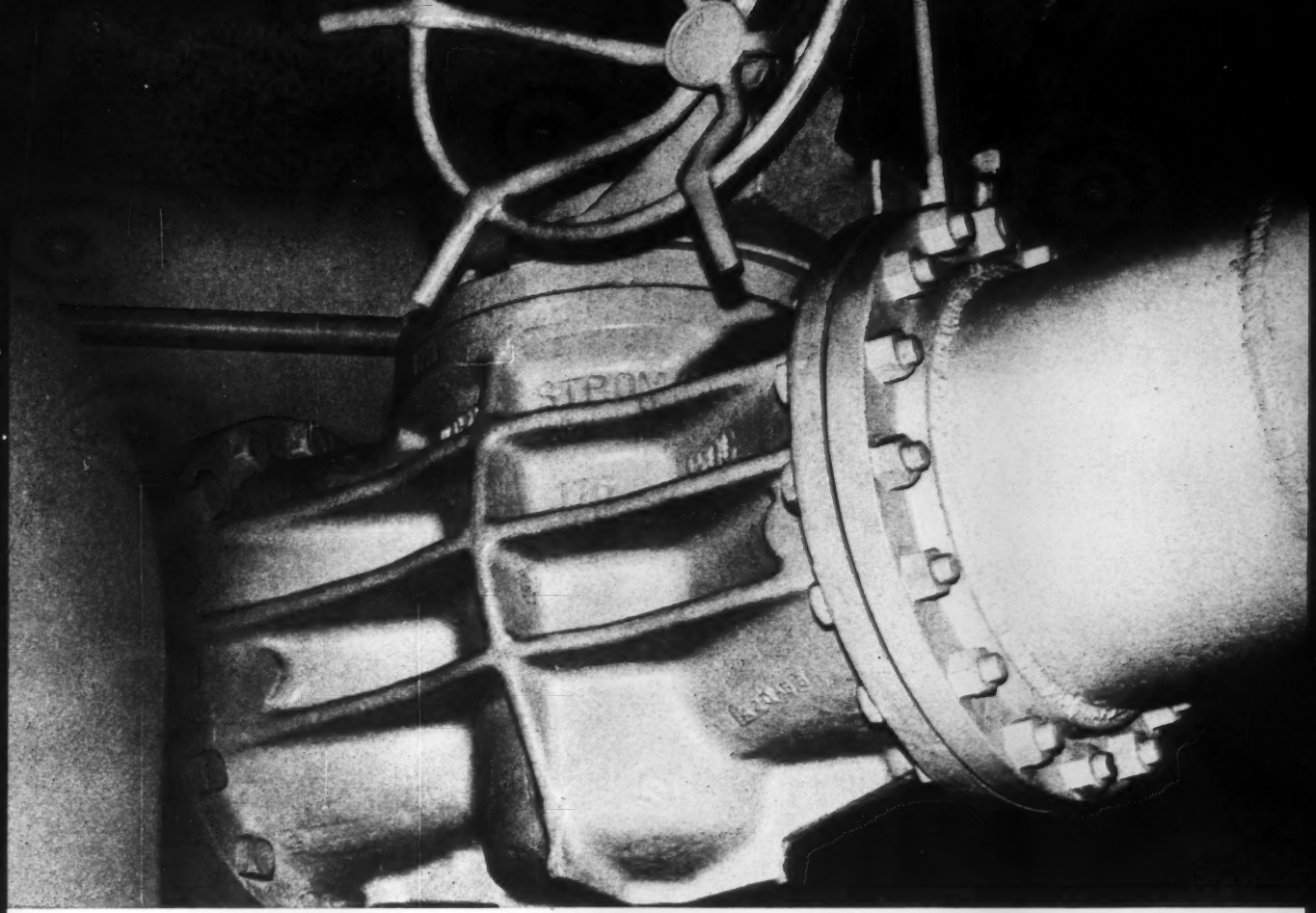
B. K. Paget
Thermotank, Inc.

READER ASKS—

"How Should I Ventilate Large Cafeteria Kitchen?"

"An extensive and complete ventilating system was installed when a modern cafeteria was built three years ago, but the 41 burners in the kitchen, when all are operating, proved to be too much for the system. The temperature in the kitchen is unbearable for the four cooks, bakery personnel, and other occupants. What is the best approach in revising an existing ventilating system in a cafeteria kitchen so that it will perform satisfactorily? I would like to use refrigerated spot cooling to help solve this problem, but it would take many tons of refrigeration capacity to remove the burner load alone. There must be some more practical method than this. I would appreciate seeing how other HPAC readers have attacked similar problems." — T.R.B.

• *YOU ARE INVITED to contribute a question for publication or an answer to a published question. Write: The Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*



WHY is the trend toward

LUBRICATED PLUG VALVES

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SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

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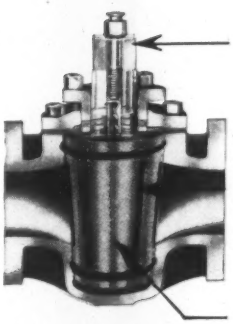

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☐ Please send Bulletin V-203 on valves for heating, piping and air conditioning installations.

☐ Please have your representative call.

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question of the month

"How Should Central Plant Heating Be Controlled For Multi-Building Heating Installation?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other solutions or comments for publication are invited.

"Several existing buildings, each having its own hot water heating system, are to be heated from a centralized boiler house. The new mains will be low pressure forced hot water, the pump requirements being 300 gpm against a 25 ft head. Two of the existing buildings are required to have some form of automatic heat control, preferably a three-way mixing valve to regulate the heat output in accordance with the outside temperature.

"I believe the way to do this is to have another pump to circulate the required amount of water through the local heating circuit. As the pump for the mains will be much larger than the pump on the local circuits, the circulation will tend to be reversed, no heat control then being possible. To overcome this, I understand a small cylinder may be inserted where the mains connect to the local system, the flow and return of the mains connecting to one side of the cylinder, and the flow and return to the branches connecting to the other, allowing the pressure difference across the mains to be dissipated.

"If this is so, I would like to know how to size the cylinder, or what should be done.

"Each building requires some 600,000 Btu per hr, and it is assumed that the individual systems were originally designed for an outside temperature of 30 F and flow and return temperatures of 180 to 140 F."—L.A.D.

Local Circulating Pumps Are Best; But Can Be Eliminated for Economy

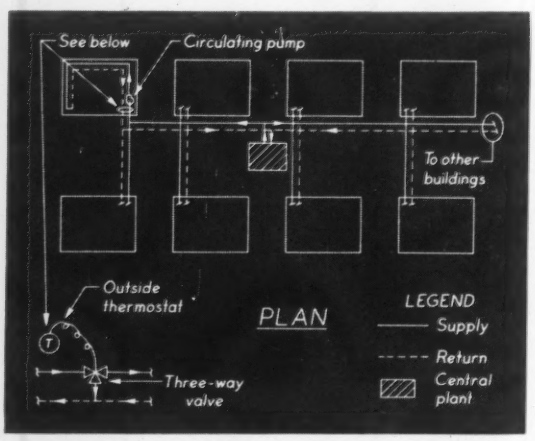
IT IS ASSUMED from the figures given by L.A.D. that there are approximately 10 existing buildings to be heated from a central boiler plant and the pump head of 25 ft includes for the longest run to the wall of one of these buildings.

The use of circulating pumps to handle the local heating circuits is definitely the best method to aid individual control of each building. But if economy is necessary, the load on each building is comparatively small and the head on the main circulating pump could be increased to handle the additional load and the individual circulating pumps could be eliminated. If it is necessary to limit the pump head to 25 ft, the mains could be oversized.

There is no apparent reason to install a "small cylinder" where the mains connect with local systems, as the entire system will be under one pressure.

The use of a three-way mixing valve actuated by an outside thermostat is a good way to provide thermostatic control in a building of this size, providing the internal design temperature is the same throughout. It is advisable to provide temperature control in each building, as the cost for installation of a three-way valve is moderate compared with the amount of fuel that will be conserved.

It is also suggested that the temperature of the sys-



1 THREE-WAY VALVE in each building, activated by outside thermostat, is good way to provide thermostatic control

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...new full-flow gate valve that throttles like a globe!

You've never seen a valve like this newly designed HUSKY conical gate. New shape, new closure principle that provides unrestricted flow, but can be throttled from shut to wide open. And, there's practically no wear out. These new HUSKY features, together with its low price, permit contractors to greatly upgrade all installations. Presently available at wholesalers in ½" and ¾" sizes (solder end or threaded).

FEATURES

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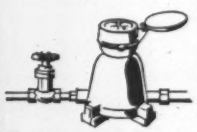
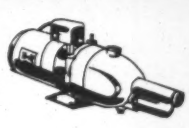
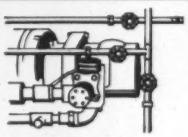

Water & Gas Meters

Radiators


Water Pumps


Air Lines

Fuel Supply ...and many others

HUSKY BRASS VALVES

NIBCO INC.

NIBCO INC., Dept. K-6404
Elkhart, Indiana

question of the month

Continued

tem be slightly increased to minimize the sizes of the heating mains, i.e., 200 F supply and 180 F return.

WILLIAM B. KOERNER
Mechanical Engineer
Daniel, Mann, Johnson & Mendenhall
Grad Engineering Associates
Seelye Stevenson Value & Knecht
Architect-Engineer Joint Venture

Primary, Secondary Circuits Need Zone Control for Best Results

THE HEATING SYSTEM described by L.A.D. contains primary and secondary circuits requiring zone control for effective and efficient results. He does not indicate the type of buildings being served by the systems. Multi-story structures are affected more by sun and wind than low-level buildings. Also, air stratification tends to cause overheating of the upper building areas and to produce cold, drafty lower levels. For these reasons, zone control should be considered.

The primary circuit may be either a one-pipe or two-pipe direct return or a two-pipe reverse return, with the primary pump circulating water through the primary circuit continuously.

Fig. 1 is an elementary diagram showing principal components for a one-pipe direct return heating system. With this design, for effective heating, the temperature drops should not exceed 20 F. If greater drops are employed, larger radiation is usually necessary to compensate for the decreased mean water temperature at the end of the piping circuit. Since the common piping in this system is part of the main, balancing is not required. Usually, this arrangement requires lower first cost than for a two-pipe primary main having the same temperature drop.

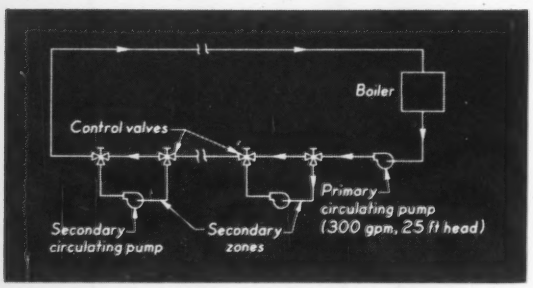
Details of a two-pipe direct return piping design are indicated by Fig. 2. This hookup has the common pipe located in a zone bypass line which connects the supply with the return main. An advantage of this arrangement is that the same quantity of water flows continuously through the bypass, whether or not the zone requires heat. However, each bypass line must be balanced. If piping sizes are not correct, use of balancing valves is necessary. Installation of flow indicators in the bypass line of each zone provides easier flow adjustment. This design allows temperature drops greater than 20 F.

For many applications, a two-pipe reverse return system, Fig. 3, is preferred to a two-pipe direct return circuit. Since all of the bypass lines are nearly of the same length, it is usually easier to balance the primary circuit.

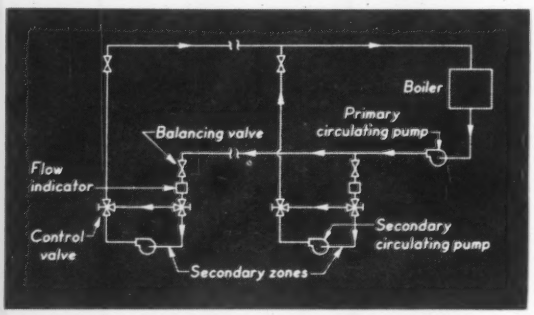
As previously mentioned, type and layout of the buildings influence selection of a heating system. It is recommended that L.A.D. review the various types of hot water heating systems applicable to his installation. By estimating fixed charges (first cost) and operating expense (direct cost), he can select a design offering lowest total annual expense.

H. B. WAYNE
Consulting Engineer

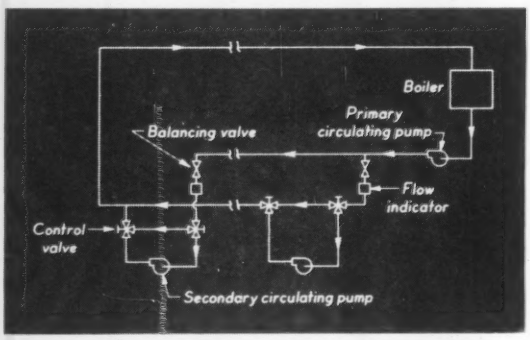
For this month's new question, turn to page 108.



1 ONE-PIPE DIRECT RETURN heating system diagrammed above. Temperature drops should not exceed 20 F without larger radiation



2 TWO-PIPE DIRECT RETURN system has common pipe located in zone bypass line which connects supply with return main



3 TWO-PIPE REVERSE RETURN system is easy to balance, since all bypass lines are nearly same length

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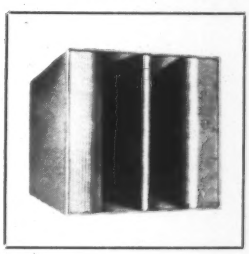

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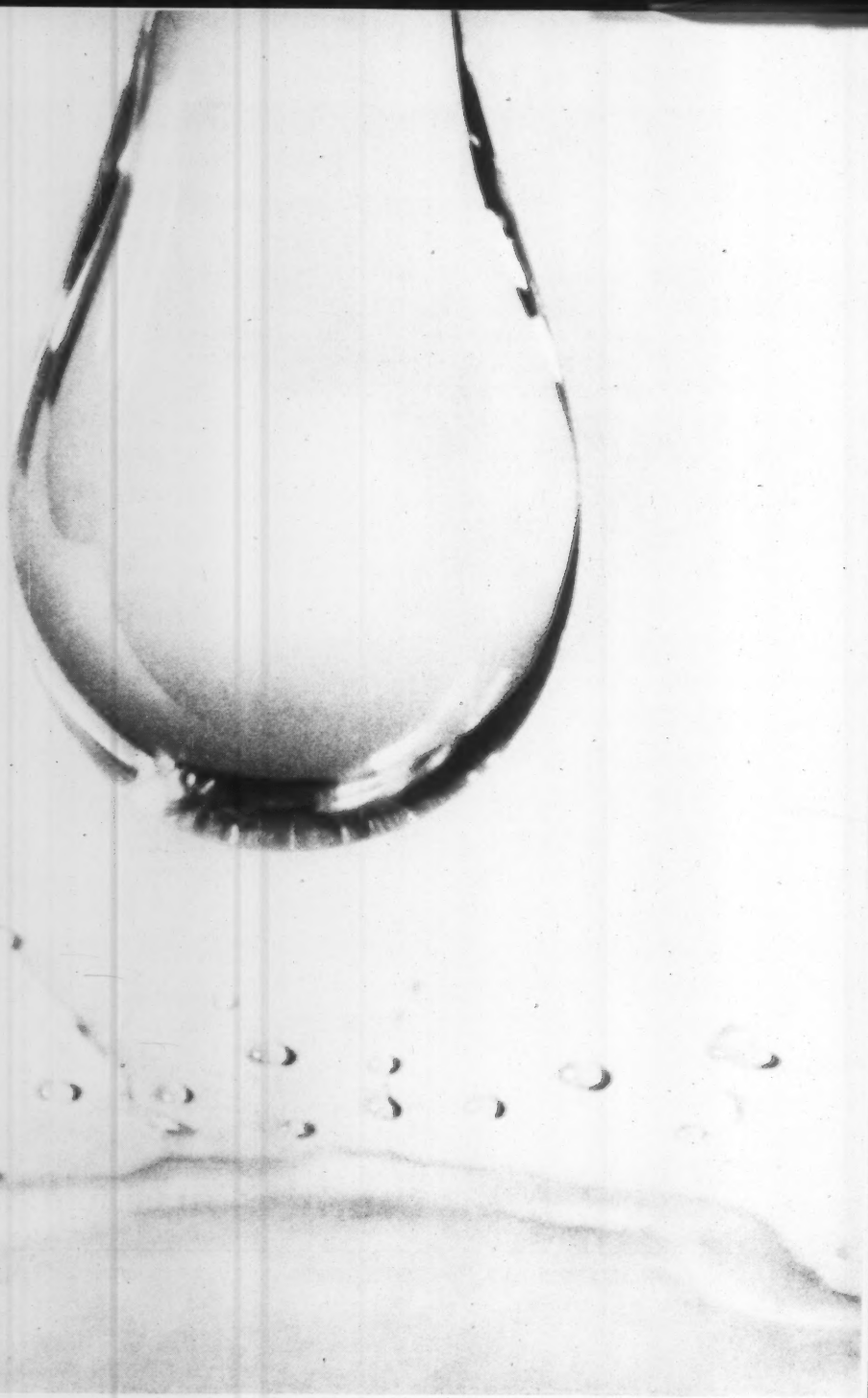
water



comes in oceans, rivers, lakes, wells,
drops, buckets, pitchers and glasses.
it quenches thirsts, cooks food, puts
out fires, makes coffee and
brushes teeth. it spins mills,
runs electro-plants, cools motors
and power factories.
it spawns fish, sprinkles lawns,
floats boats, washes children
and grows flowers.

it sustains and nurtures.
it bends if you give it purpose.
it reshapes itself if you give it reason.
it is needed, wanted, feared,
praised and prayed for.

it is at the heart of all life.
it is in the arteries of all industry.
it is as close to us as skin
but as taken for granted as sky.

the end of water seems unbelievable.
if it is not on the horizon, it is just over it.
if it is not within sight,
it is just 'round the bend.
if it is not in the glass,
it is just in the spigot.

. . . this is the grand mirage . . .
the self-delusion that prevails
though the wells run low
and the streams go dry
and the water slips away.

we know water.
we know its ways.
we've learned its habits.
we've pulled it out of swamplands,
pushed it over mountains,
pumped it into deserts,
tunneled it through granite,
and rescued it from pollution.

above all else,
we know the need for it.
that is why,
for 130 years,
we've developed new uses for,
powered new factories with,
diverted the courses of
and jealously stood guard over
water.

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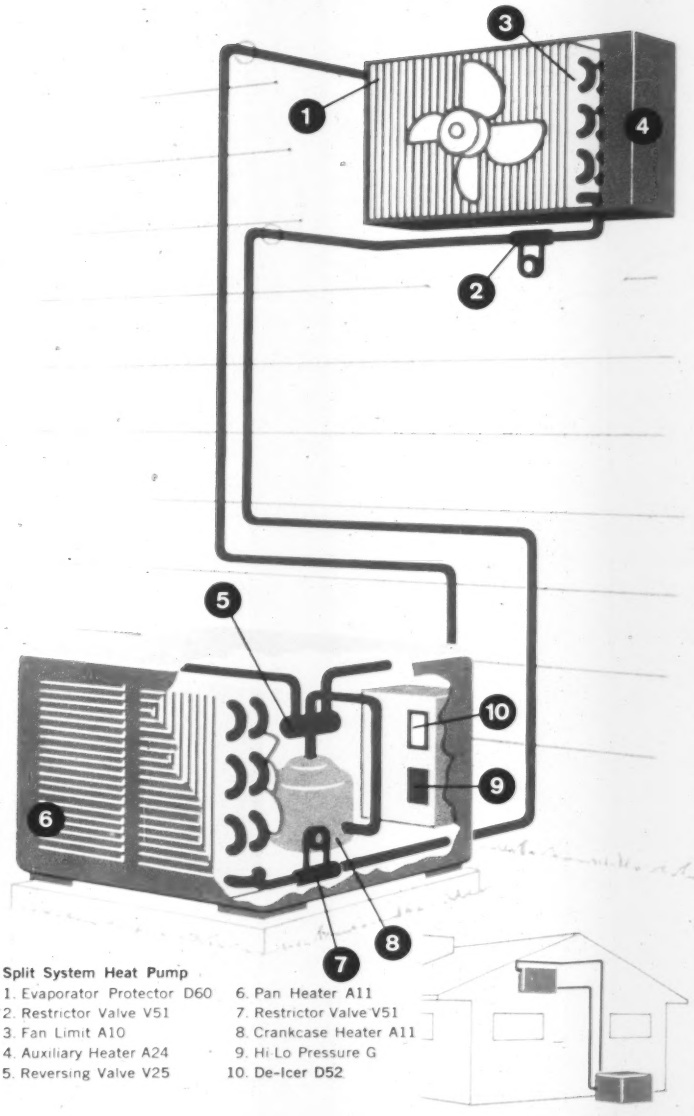
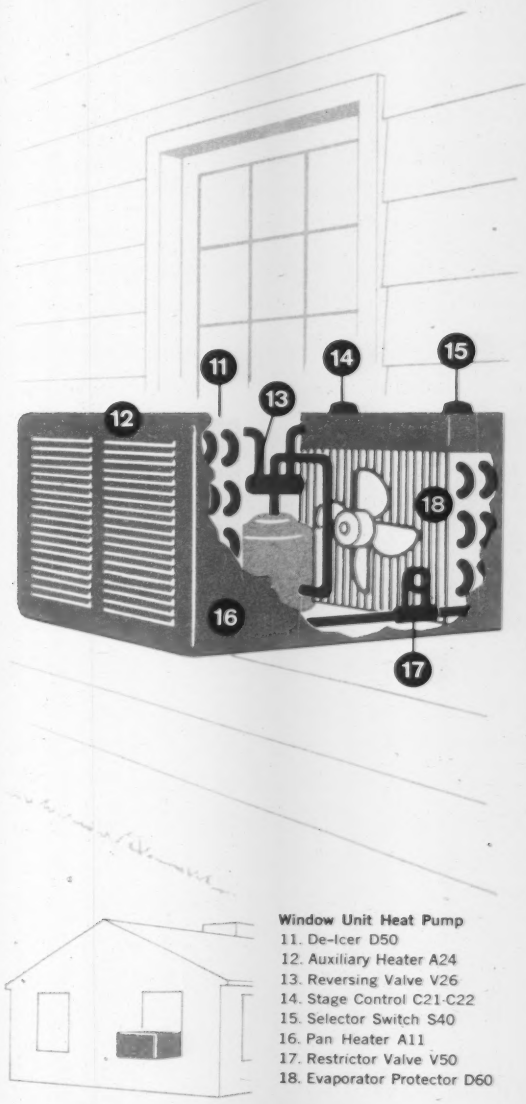


Split System Heat Pump

1. Evaporator Protector D60
2. Restrictor Valve V51
3. Fan Limit A10
4. Auxiliary Heater A24
5. Reversing Valve V25
6. Pan Heater A11
7. Restrictor Valve V51
8. Crankcase Heater A11
9. Hi Lo Pressure G
10. De-Icer D52



Window Unit Heat Pump

11. De-Icer D50
12. Auxiliary Heater A24
13. Reversing Valve V26
14. Stage Control C21-C22
15. Selector Switch S40
16. Pan Heater A11
17. Restrictor Valve V50
18. Evaporator Protector D60

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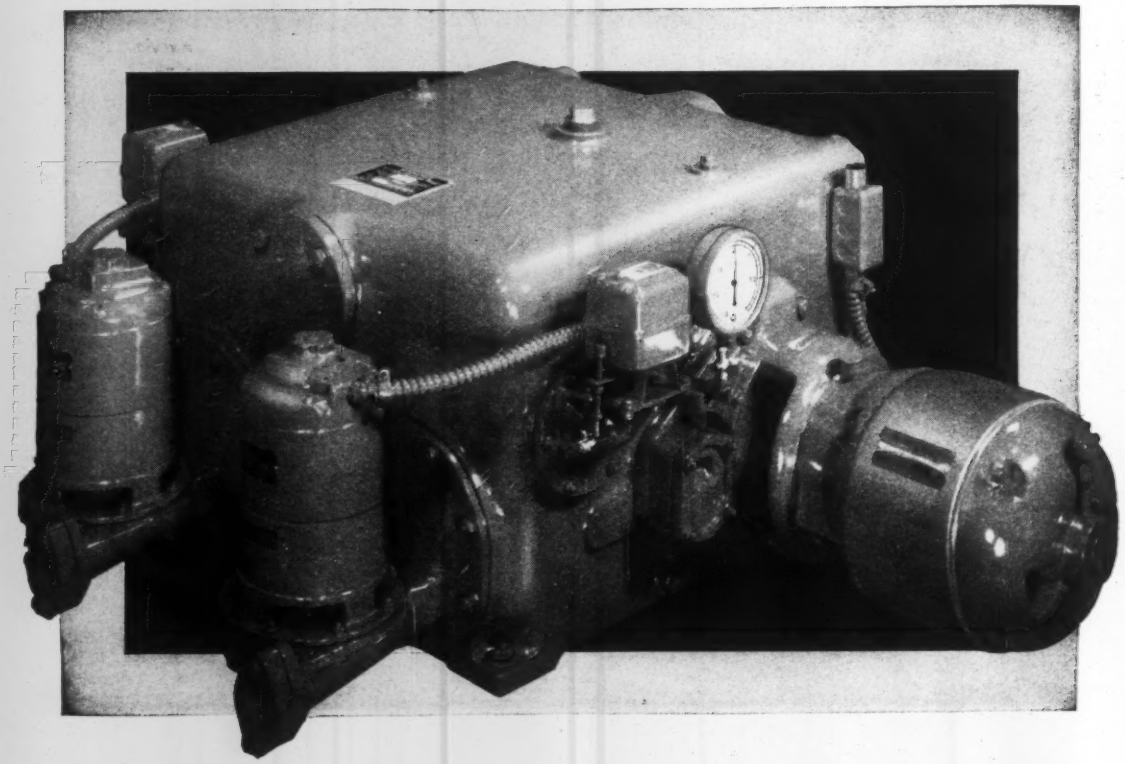

It's the Nash CSM

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These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

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Three-Pipe System Lets Hotel Guests Choose Their Own Comfort

• Each of the 1228 guest rooms in Boston's Statler-Hilton Hotel is now a separate heating and cooling zone. By incorporating a basic change into the tentatively planned conventional induction system, each guest can select his own comfort the year 'round. This change, which involves running separate hot and chilled water lines to each room unit, features a newly developed guest-operated valve which admits either hot or chilled water to the coil. Advantage was taken of existing heating boilers by installing a combination of a steam turbine driven centrifugal compressor exhausting into an absorption refrigeration unit.

BY LEWIS SMITH
Heating Engineer

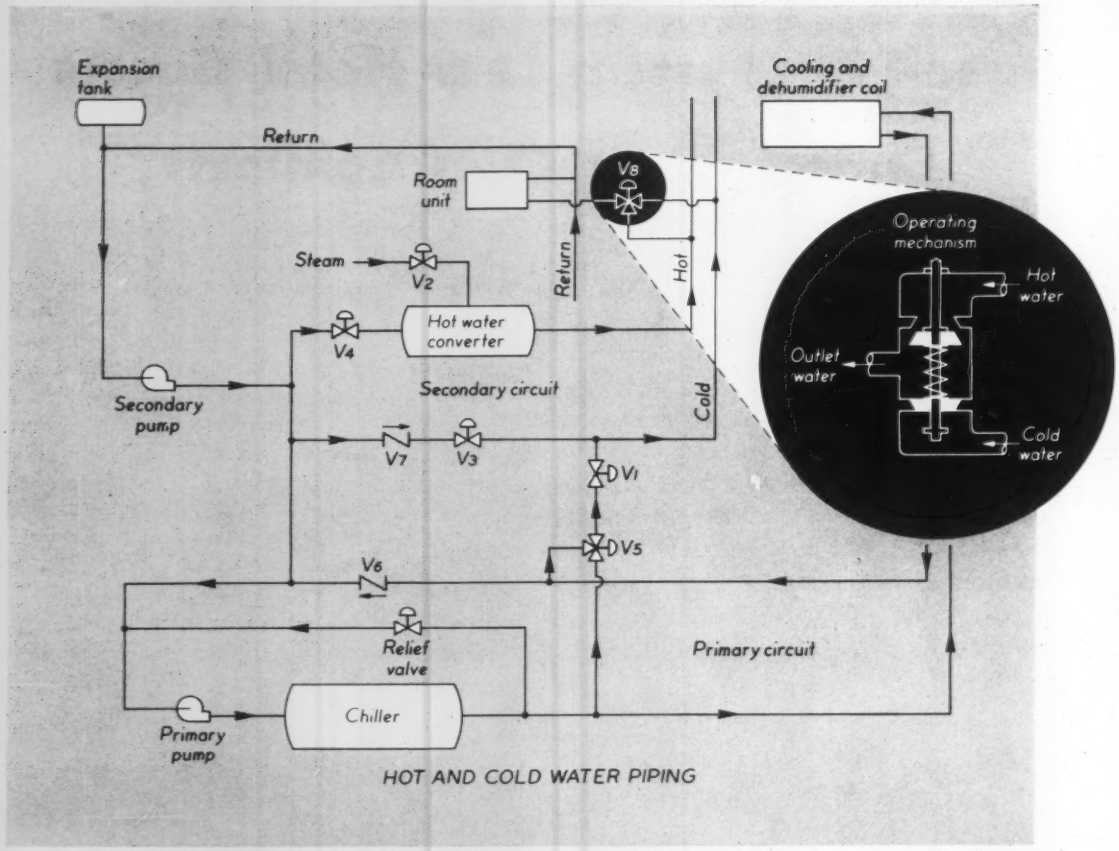
WHEN THE Hilton Hotels Corp. decided, in February 1959, to go ahead with the air conditioning of the 1228 guest rooms in the Statler-Hilton Hotel in Boston (the public spaces were already air conditioned), tentative plans had been prepared in advance by their own engineering staff for what is now commonly called the "conventional" induction system.

But before work got underway, a basic change was proposed which the Hilton people, with their wide experience with all kinds of systems, thought would produce a more flexible system — one better suited for the special and unpredictable reactions of hotel guests, a service which is in effect for the guests 24 hours each and every day of the year.

In no other type of building is the change in occupancy as rapid as in a hotel. In no other class of service are the demands for comfort as great or as variable from day to day.

The proposed change was to run separate hot and chilled water lines to each room induction unit

THE STATLER-HILTON, previously cooled only in its public spaces, now offers its customers air conditioned guest rooms as well. Hotel management recognized installation of air conditioning as vital business investment



1 HOT, CHILLED WATER PIPING circuits for this installation are diagrammed above. Inset shows room unit control valve. Valve stem can be moved up and down by electric or pneumatic means or by direct-acting thermostatic bulb. In position shown, there is full flow of hot water and no chilled water. Spring keeps valves against collar on stem or seat according to position of stem, letting cold or hot water, but not both, flow. In mid position both valves are closed

(but to use a common return). A newly developed valve was to be installed at the inlet to each unit to admit either hot or cold water to the unit coil (but not both) to satisfy room temperature and the whims of the guest.

The primary air, which is for ventilation only and is 100 percent outdoor air, is kept at a fairly constant temperature the year 'round. Thus the unit coil acts as a booster to raise the temperature of this air in winter or whenever heating is required, and to lower it in summer or whenever cooling is required.

Since cold water is always available, room temperatures can be lowered at night and held steady to cater to those guests who like cool rooms for sleeping.

The scheme was submitted to and approved by the hotel's consulting engineers, Jaros, Baum & Bolles.

This inlet valve is not of the mixing type, but is arranged so that in one position it will admit a modulated flow of hot water and in the other position a modulated flow of chilled water, there being a mid position where there is, for a time, no flow.

It may be said that this valve makes this system feasible by mixing the hot and cold water, not in the coil of the unit, but in the returns after it has passed through the unit when the temperature difference is small. (This will be explained later.) The valve is positioned by a direct acting thermostat behind the recirculating air grille of the unit in the room air entering the coil.

From this abbreviated and simplified description it will be apparent that, with hot and chilled water available at all times, the guest may select whatever temperature he desires (within the range of the thermostat) by manually setting the indicator on the unit.

Thus each room becomes a zone in itself, completely independent of all other rooms. Hence there is no need for zoning the system and the guest is not limited to the use of whatever water temperature is being circulated in the zone supplying his particular room.

Two questions may well be asked:

1) What happens to the return water in the common line when

some units are cooling and others are heating?

2) How do the circulating pumps know which way to pump the water and in what proportion through the converter or chiller?

In the months when no cooling is needed, all units will be discharging hot water into the return line. Similarly, in those months when no heating is needed, all units will use chilled water. It is only in those months when some rooms may call for heating and others for cooling that cold and hot water will mix in the returns.

Actually, the terms "hot" and "chilled" water are wrongly used. Bear in mind that during these in-between months both the heating and the cooling loads are very light. Therefore the flow of water is small and the temperature drop or rise through the units is high. This tends to equalize the outlet temperatures and bring them toward the room temperature.

Note also that no summer-winter changeover is needed, this being automatically taken care of by the action of the one thermostat on the room unit. The guest can have cooling or heating any time.

Two Throttling Valves Used

As shown in Fig. 1, there are two throttling valves, V1 and V4, which are in the chilled water and hot water supply lines, respectively. Both are controlled by the pressure differential between their respective supply lines and common return.

Thus, if the demand for hot water is heavy, V4 will open up to maintain the proper pressure at the room unit for the full flow of water. If the demand is low, the pressure at the unit inlet would tend to rise and cause excessive flow to other units. But V4 throttles down in response to this rise in pressure.

The same cycle is followed on the cold water side with valve V1. The return water is pumped into each circuit according to the demand. At the same time, the motor horsepower is reduced. Valve V2 is controlled by a bulb in the hot water leaving the converter and varies the steam supply to adjust the water temperature according to the outdoor temperature.

Valve V5 is three-way and is normally set to inject chilled water from the primary circuit into the secondary circuit cold water supply line. Valves V3 and V1 are thermostatically controlled to mix chilled water and return water to maintain a set temperature of the cold water going to the room units.

In winter the chiller can be shut down and valve V5 manually positioned to feed return water from the dehumidifier coil into the secondary circuit since this return water will be sufficiently cool for the conditions existing at that time.

No Bypass Around Pumps

The arrangement of the secondary circulating pumps is rather unusual in one respect: There is no bypass with relief valve around the pumps. Fig. 1 indicates that there are three paths through which the secondary water can flow; i.e., through valves V1, V3, or V4. Thus there will always be some flow and a bypass is unnecessary. In fact, with this scheme, while the pumping head rises, the reduction in flow results in a decline in horsepower which would not be the case when a bypass is used to maintain practically design conditions of head and flow regardless of the actual flow through the system.

The primary air quantity is based on the requirement for ventilation only. It is therefore somewhat less than usual for a system using induction units, because it is not necessary to provide air to compensate for transmission losses.

Zoning, for exposure and the consequent need for reheat coils are not needed — again, each room is a zone in itself — but on this particular job there are two separate air systems as a matter of convenience in installation.

Air in summer is cooled to 48 F and in winter is heated to 40 F with a glycol filled preheat coil which also serves to protect the dehumidifier coil from freezing. The total air handled is 71,600 cfm, an average of 56 cfm per guest room. This air leaves the rooms through the bathroom exhaust system.

Take Advantage of Boilers

Because of the limited space available for the new refrigeration equipment and the difficulty of getting it into the basement, advantage was taken of the fact that the hotel had boilers generating steam at 150 psi to install a combination of a steam turbine driven centrifugal compressor exhausting at 9 psi back pressure into an absorption unit.

The total cooling capacity of 812 tons was divided, 574 tons in the absorption unit and 238 tons in the centrifugal unit. When operating at or near full capacity this arrangement produces a low rate of steam per ton by using the steam in two stages.

The centrifugal unit can be shut down and steam fed to the other unit through a pressure reducing valve, thus providing a measure of standby service for repairs.

The installation was completed last fall. Structural changes and certain other work were taken care of by the hotel. As can be expected when fitting an air conditioning system into such a large existing building, and especially a hotel, it has been necessary to make adjustments and minor changes after getting into full operation. However, the hotel management is satisfied that they have invested in a system that will give them still better performance than has been achieved in their other modernization jobs of this kind — both as to guest comfort and economy. ∓

Why Stainless Steel Is Used For Process Piping

• Stainless steel piping systems are used for many process applications. Some of these are for petroleum, pharmaceutical, food, and chemical services, and for other processes where corrosion and product contamination are factors. Likewise, in the field of cryogenics, at the one temperature extreme, and for high temperature service, at the other, stainless steel systems have exhibited their ability to perform well. Herein, Arthur C. Wicker analyzes stainless steel, explaining the effects of various alloying agents, and discusses the nominal chemical compositions and physical properties of the more important stainless steel alloys.

Mr. Wicker is a 1948 chemical engineering graduate of the University of Louisville. As an alloy specialist, his chief interest lies in the field of corrosion and corrosion resistant piping materials. He is a member of NACE, ASM, SPE, and AICE.

BY ARTHUR C. WICKER
Alloy Specialist
Tube Turns Div.
Chemetron Corp.

INDUSTRY is using stainless steel for piping on an ever-increasing scale and, in all probability, will continue to do so since it comes close to being "all things to all men." Two reasons for this popularity are:

1) Its combination of physical and mechanical properties. Stainless steel resists corrosion, protects products from contamination, proves satisfactory at both sub-zero and elevated temperatures, and resists embrittlement by hydrogen and hydrogen-containing fluids at high pressures and temperatures.

2) Its economics. While stainless steel piping systems may cost more than piping systems of other materials, they may represent the wisest investment in the long run. Often, expensive downtime is avoided, replacement costs are reduced, hazards to life and property are eliminated, and loss of product by contamination and leakage is averted when stainless steel is employed.

Stainless steel is ordinarily defined as a ferrous alloy containing at least 11.5 percent chromium. The three main varieties are:

1) *Austenitic.* These chromium-nickel steels are used for general corrosion resistance. Those with about 18 percent chromium and 8 percent nickel, with or without modifications for special purposes, are by far the most widely used for piping.

2) *Ferritic.* These nonhardenable, straight chromium steels are employed where service conditions make the addition of nickel unnecessary.

3) *Martensitic.* Hardenable by heat treatment, these stainless steels are used principally for cutlery, surgical instruments, poppet valves for internal combustion engines, turbine blades, etc.

Various elements are alloyed with steel to produce these three types of stainless steels. Each of these elements imparts certain properties and is used in greater or lesser amounts according to the service requirements of the end product.

Chromium is the basic alloying element for imparting chemical passivity to stainless steels. This passivity, or chemical corrosion resistance, is due to the formation of a thin surface layer of chromium oxide that strongly inhibits further chemical attack. Corrosion resistance can be improved by increasing the chromium content up to a maximum of about 29 percent. By properly balancing the various alloying elements, especially carbon and nickel, a wide range of strength and corrosion resistance is available with these austenitic alloys.

Nickel, the element of second importance to chromium, enhances the forming properties, high temperature properties, welding, and particularly the low temperature properties of the austenitic steels. Additionally, nickel increases their ability to handle a variety of corrodents, such as alkalies, neutral chloride solutions, and certain acids. (In the 200 Series, about half of the nickel is replaced by half again as much manganese.)

Molybdenum increases elevated temperature strength and further improves the corrosion resistance of stainless steels, particularly to hot organic acids and sulfurous and sulfuric acids. It inhibits pitting corrosion in neutral chloride solutions, such as sea water, and also increases creep and rupture strength.

When *columbium* (or *columbium-tantalum*) is added to stainless steel in the ratio of 8 to 10 times the carbon content, chromium carbide precipitation is strongly inhibited. The columbium has a greater affinity for carbon than does chromium. As a result, the carbon precipitates as columbium carbides rather than as chrome carbides when the material is exposed to temperatures in the sensitizing range. Thus, the chromium remains in solid solution throughout the grain and thereby affords protection against intergranular corrosion. It also increases creep and rupture strengths substantially.

STAINLESS STEEL GLOSSARY

Aeration: Mixture of air or oxygen with chemical solutions, usually acids; ready availability of air or oxygen for chemical reactions means an increase in rate of corrosion.

Anode: Electrically positive pole is an electrolytic cell; pole at which oxidation occurs; the less noble metal in the galvanic series.

Austenitic: Type of crystalline structure of metal (nonmagnetic).

Cathode: Electrically negative pole in an electrolytic cell; more noble metal in galvanic series.

Electrolyte: Media capable of carrying an electric current; in galvanic corrosion, the electrolyte carries current between dissimilar metals.

Ferritic: Type of crystalline structure of metals (magnetic).

Halogen: Chemically related family of elements consisting of fluorine, chlorine, bromine, iodine.

Ion: Electrically charged atom or molecule.

Martensitic: Type of crystalline structure of metals (magnetic).

Neutral chloride solution: Solution of a chloride salt which is neither acidic nor alkaline.

Oxidation: Type of chemical reaction in which electrons are given up; usually thought of in combination with oxygen.

Oxidizing agent: Chemical which readily takes on electrons; lends itself strongly to oxidation.

Passivity: Resistance to chemical corrosion; usually maintained by the formation of a thin invisible coating of metal oxide which strongly resists further oxidation (corrosion).

Reduction: Type of chemical reaction in which electrons are gained; opposite of oxidation.

Salt: Chemical compound formed by the reaction of an acid with a base.

The addition of *titanium* to stainless materials, in the ratio of 4 to 6 times the carbon content, also serves to prevent carbide precipitation. Since titanium's affinity for carbon is greater than chromium's, it provides protection against intergranular corrosion by causing carbon to precipitate as titanium carbides rather than as chromium carbides at sensitizing temperatures. It also adds to creep and rupture strength.

Regardless of how complicated the analysis of a particular stainless steel alloy may be, it is certain to fall into one of three well-defined groups or series: the 200 Series, the 300 Series, and the 400 Series. In the industrial piping field, the 300 series is in widest use, Types 304, 304L, 316, 316L, and 347 being the grades most generally employed.

200 *Series:* The newest members of the stainless steel family are represented by the 200 Series. They are of austenitic structure and are nonmagnetic, and contain substantially more manganese and less nickel than their counterparts in the 300 Series. The mechanical and physical properties of the 200 and 300 Series are similar.

The corrosion resistance of the 200 Series (cur-

rently limited to Types 201, 202, 204, and 204L) is generally equal to, or slightly less, than that offered by the 300 Series.

These alloys should not be employed where the properties of their counterparts in the 300 Series are considered marginal for the service involved.

300 Series: Stainless steels in the 300 Series, likewise austenitic in structure, are nonmagnetic and basically an 18 percent chromium-8 percent nickel alloy. They are commonly called the 18-8 series and consist of 20 basic alloys. This series offers excellent resistance to corrosion and mechanical wear, a high order of fabricability, and a wide selection of types to meet specific conditions. The types most frequently used for industrial piping are discussed as follows:

Type 304 affords ample resistance to the many relatively mild corrosive conditions found in the chemical, oil, textile, dairy, food, and other processing industries.

Types 309S and 310S resist the same corrodents at higher concentrations and temperatures. Type 309 or 310 is also used where exceptional protection against attack by oxidizing agents must be provided, plus improved general corrosion resistance. Type 310, in particular, offers superior resistance to gaseous corrodents—even those including sulfur compounds at high temperatures.

Type 316 contains 2 to 3 percent molybdenum, which greatly increases its ability to resist pitting. Pitting is the result of an attack on the chrome oxide layer by a reducing chemical. Once a break is made in the oxide armor, galvanic corrosion proceeds at an accelerated rate. The molybdenum present in Type 316 resists the action of reducing agents, such as chlorides and other members of the halogen family, and withstands very dilute sulfuric and sulfurous acids, phosphoric acid, acetic acid, and a variety of reducing acids.

Type 317, with its higher molybdenum and nickel content, provides still greater resistance to corrosive attack and is frequently given consideration for high temperatures.

Types 321, 347, 316Cb, and 309Cb are stabilized stainless steels and are recommended for corrosion resistance at elevated temperatures and where a post-weld solution heat treatment cannot be carried out.

What Is Stabilization?

Perhaps a short explanation of what is meant by stabilization would be in order here: When unstabilized austenitic stainless steels are heated and slowly cooled through or allowed to remain in the 850 F to 1650 F temperature range for what would normally be considered a relatively short period of time, precipitation of chromium carbides will occur. As these materials cool slowly or are held in this temperature range, atoms of chromium and carbon combine at the grain boundaries, leaving a deficiency of chromium in the areas immediately adjacent to the grain boundaries. This renders these chromium depleted areas vulnerable to attack by various corrosive media. The appearance of this type of corrosive attack, when viewed through a microscope, has suggested the name *intergranular corrosion.*

Stabilizing elements such as titanium, columbium, and tantalum are strong carbide formers. As such, they have a stronger affinity for carbon than does chromium. These elements unite with the carbon to form rather stable carbides of these elements, thereby preventing the formation of chromium carbides and permitting the chromium to remain in solid solution.

In the regular unstabilized austenitic stainless steels, chromium carbines which may have been formed can be redissolved by heating between 1900 and 2100 F, depending on the grade, and then cool-

TABLE 1 — NOMINAL CHEMICAL COMPOSITIONS[1] for more important types of stainless steel are given below

Type	Chromium	Nickel	Carbon (max)	Manganese (max)	Silicon (max)	Molybdenum	Other
201	16.0-18.0	3.5-5.5	0.15	5.5-7.5	1.0	-	-
202	17.0-19.0	4.0-6.0	0.15	7.5-10.0	1.0	-	-
204	17.0-19.0	4.0-6.0	0.08	7.5-10.0	1.0	-	-
204L	17.0-19.0	5.0-7.0	0.05	7.5-10.0	1.0	-	-
304	18.0-20.0	8.0-13.0	0.08	2.0	0.75	-	-
304L	18.0-20.0	8.0-13.0	0.03	2.0	0.75	-	-
309	22.0-24.0	12.0-15.0	0.15	2.0	0.75	-	-
309S	22.0-24.0	12.0-15.0	0.08	2.0	0.75	-	-
310	24.0-26.0	19.0-22.0	0.15	2.0	0.75	-	-
310S	24.0-26.0	19.0-22.0	0.08	2.0	0.75	-	-
316	16.0-18.0	11.0-16.0	0.08	2.0	0.75	2.0-3.0	-
316L	16.0-18.0	11.0-16.0	0.03	2.0	0.75	2.0-3.0	-
317	18.0-20.0	11.0-14.0	0.08	2.0	0.75	3.0-4.0	-
317L	18.0-20.0	11.0-14.0	0.03	2.0	0.75	3.0-4.0	-
321	17.0-20.0	9.0-13.0	0.08	2.0	0.75		Ti 0.40-0.60*
347	17.0-20.0	9.0-13.0	0.08	2.0	1.00		Cb+Ta 0.80-1.00*
348	17.0-20.0	9.0-13.0	0.08	2.0	1.00		Cb+Ta 0.80-1.00* (Ta 0.10 max)
405	11.5-13.5	0.50 (max)	0.08	1.0	0.75		Al 0.10-0.30
410	11.5-13.5	0.50 (max)	0.15	1.0	0.75	-	-
430	14.0-18.0	0.50 (max)	0.12	1.0	0.75	-	-
446	23.0-30.0	0.50 (max)	0.20	1.5	0.75	-	-

[1]The nominal range of the nickel content in Types 304, 304L, 306 and 316L steels may vary from those shown in the foregoing table. While the normal nickel content in Types 304 and 304L is 8.0 to 11.0, a nickel range of 8.0 to 13.0 is required when these materials are processed into seamless pipe. The nickel range in Types 316 and 316L is 11.0 to 14.0 when they are employed in the production of welded pipe, and 11.0 to 16.0 when they are employed in making pipe of seamless construction.

*Approximate.

TABLE 2 — NOMINAL PHYSICAL PROPERTIES of different stainless steels are listed here

Type	Minimum yield, psi	Annealed state ultimate tensile strength, psi	Elongation in 2 in., percent
201	50,000	115,000	55
202	50,000	100,000	50
204	50,000	100,000	50
204L	50,000	100,000	50
304	30,000	75,000	40*
304L	25,000	65,000	40*
309	30,000	75,000	40*
309S			
310	30,000	75,000	40*
310S			
316	30,000	75,000	40*
316L	25,000	65,000	40*
317	30,000	75,000	40*
317L	25,000	65,000	40*
321	30,000	75,000	40*
347	30,000	75,000	40*
348	30,000	75,000	40*
405	30,000	60,000	20
410	30,000	60,000	20
430	35,000	60,000	20
446	40,000	70,000	18

*Longitudinal direction; 25 percent for transverse direction.

ing at a fast enough rate to keep the chromium carbides from forming at the grain boundaries as the steel passes through the 850 to 1650 F temperature range. It should be clearly understood that this heat treatment will not be effective if the application is such that the part will be used in service in the 850 to 1650 F temperature range. Further, the above heat treatment may not be feasible because of the size and bulk of assemblies fabricated by welding. It is in these cases that stabilized austenitic stainless steels are recommended to minimize chances of intergranular attack by corrosive media. In general, the stabilized stainless steels also demonstrate superior creep rupture properties over the unstabilized grades.

Type 347 offers adequate resistance to intergranular corrosive attack in most piping applications. Its general corrosion resistance is about equal to Type 304 and is slightly better than Type 321.

Five "extra low carbon" alloys available in the 300 Series are Types 304L, 316L, 309S, and 310S. They are similar in chemical composition to their standard grade counterparts, but the carbon content is limited to 0.03 percent in the "L" types and to 0.08 percent in the "S" types.

This low carbon content decreases chromium-carbide precipitation during welding. However, these types are recognized by ASTM and ASME for temperatures up to 800 or 850 F only. Moreover, allowable stress ratings are cut back, due to the lower physical properties. For example, ratings of 316L and 317L flanges are about 20 percent under the ratings of 304 flanges.

Series 400 Is Basically Chrome-Iron Alloy

400 *Series:* Materials in the 400 Series are basically a chrome-iron alloy, with little or no nickel content. The various grades may be either martensitic or ferritic in structure and are magnetic. Like the austenitic stainless steels, they offer outstanding resistance to oxidizing media; but they are more likely to be attacked in services involving corrosive solutions under deaerated or reducing conditions. They are also more susceptible than the austenitic grades to pitting in the presence of halogens, particularly chlorides. Additionally, they are harder and more resistant to abrasion and to impingement and cavitation corrosion.

To aid in the identification of series designations, Tables 1 and 2 have been prepared. Table 1 gives the nominal chemical composition, while Table 2 lists the physical properties of most stainless steel alloys.

Use ASTM Specifications

ASTM specifications are employed by manufacturers of stainless steel pipe, welding fittings, and flanges, with the exception noted below. Thus, the engineer can conveniently and accurately specify material requirements, knowing that he and the manufacturer are speaking the same language.

The ASTM specifications for stainless materials are as follows:

Series	Pipe	Plate	Bar	Forgings	Welding fittings
200	No ASTM specifications have as yet been drawn up for the new stainless steels in the 200 Series. Established specifications may be used as a reference to methods of manufacture and exceptions made as to chemical and physical properties.				
300	A312 A558 A576	A240	A276	A182	A403
400	A268	A240	A276	A182	—

Compare Costs of Stainless Materials

The following table takes Type 304 stainless steel as a basis of 1.00 and gives the relative cost of pipe, welding fittings, and flanges in a range of stainless steel materials. All figures are approximations.

Type	Pipe	Welding Fittings	Flanges
304	1.00	1.00	1.00
304L	1.21	1.00	1.10
316	1.64	1.30	1.27
316L	1.84	1.51	1.52
347	1.32	1.30	2.0-4.0*
202	0.97		
310	2.01		
317	1.99	Demand for these alloys is limited. Since minimum mill runs of raw material are required, a higher pricing basis is often necessitated.	
317L	2.20		
321	1.17		
405	0.85		
446	1.02		

*Depending on size

Stainless steel pipe, welding fittings, and flanges are readily available for industrial application, although special arrangements usually have to be made to obtain certain types that are not normally sold in volume.

Weldability and the eight different kinds of corrosion that affect stainless steel will be discussed in another article in an early issue.

Should the Low Bidder Get the Job?

"Low-man-gets-it" philosophy is igniting a cost cutting chain reaction throughout the industry

BY E. W. KLEIN, JR.
E. W. Klein & Co.
Manufacturers Representatives

ATTACKS by subcontractor organizations against the undesirable bid shopping of general contractors have, without question, had adequate provocation. In fighting this, as in fighting a fire, there remains considerable water damage.

The full effects are not yet ripened, but the separate bids, the four-hour bid agreements, the depositories, and other altruistic solutions are having side effects on our industry which leave cause to ponder over their virtues.

The results can be examined by looking, in turn, at the four basic elements of our industry: (1) the mechanical contractors, (2) the jobbers and wholesalers, (3) the agents and manufacturers, and (4) the professional design agencies such as consulting engineers, engineers with architects, and others. Let's look at each of these and see how the changes in attitudes affect each element and, as in a chain reaction, carry on to the next.

Everyone would like to find an easier way to make a living. None of us would reject an offer having only elements of higher reward with no more effort. But, most will still cling to our standard American approach to a living which says, one way or another, that you must work for what you get, and if you are good enough and work hard enough you will get a lot.

Most of us in our industry believe in our free enterprise system. Few of us look to our federal government for price supports, or other subsidies of socialism. So, our industry is basically old line conservatism.

But conservatism carries with it the connotations of laboring for one's laurels. It means that in truth there is no true equality. It means that a contractor should have a reputation built on sound and fair business practices and good performance. It means the jobber must hold his position of respect in a community on the basis of his strength of character as well as strength of business acumen. The agent must be a respected businessman, and he must represent

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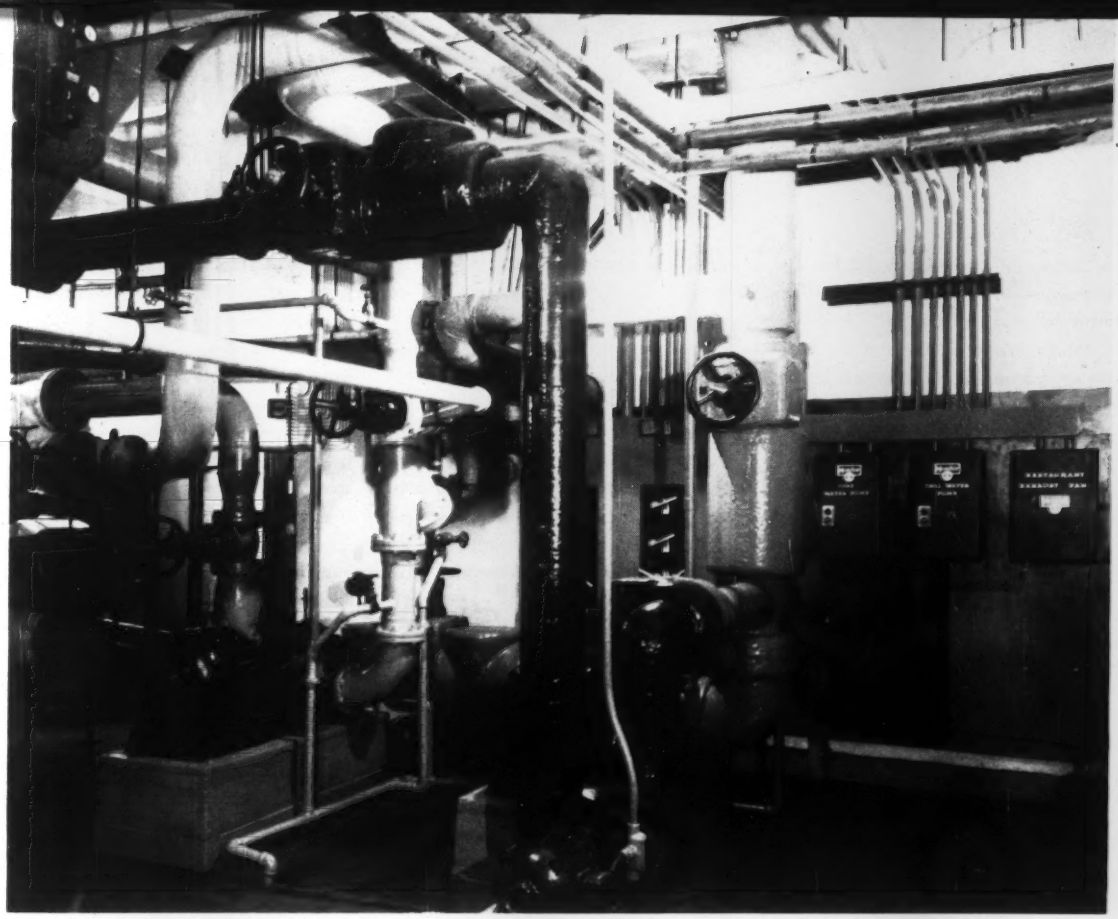


MECHANICAL EQUIPMENT ROOM of Life Insurance Co. of Georgia Bldg, Atlanta, is example of quality installation. The mechanical contractor was the Player Co.

sound manufacturers. The professional engineer and the architect must have all of these qualities, having reached a position of respect by carefully chosen stepping stones.

Contractor Asks Competition

But the mechanical contractor has too often forfeited his right to use the position for which he has labored. He now invites all of his competitors to compete with him on an equal basis. He has fallen for the low-man-gets-it theme.

He sometimes contends that all he wants is the chance to get low on a job, and to get it at that figure. He states that he wants some assurance that no one will have a chance to meet or beat his price. What he doesn't state, but what naturally follows, is that his less experienced, less qualified competitors are given a fully equal chance at the same job.

It is not that the little men should be given no chance. They are entitled to scratch out their own way in our economy. But in trying to rectify one evil of the trade, they are creating for themselves the unique atmosphere of encouraging all to join the game. They are stating that since price is the only criterion, reputation and strength are not to be considered.

Reputation Merits Confidence

But reputation built up in the past should entitle a contractor to some preferential treatment. How is he going to use it if he must agree to fix his price in advance and then not depart from it?

To the engineer and owner, the following advantages in dealing with an established and reputable contractor are obvious:

1) They both know that a high standard of workmanship will prevail, even in concealed spaces.

2) They know that if call-backs are necessary, the contractor will probably still be in business and will have the service men to handle the requirements promptly and efficiently.

3) They also know that the pride of an organization will demand a "buttoning-up" of the job on completion which will leave a better organized and better operating system for the owner.

So the apparent question arises, should they be forced to take the low bid without first seeing if a good contractor won't have it at the same price?

In the past, contractors have worked their way up from small

to large jobs, or have grown by finding the "sleepers." Why shouldn't this continue?

To the general contractor there are a number of subcontractors with whom they can and are willing to work. They know that some are better organized than others. They know that the job will go more smoothly with some than with others. The difference may be something which is not accountable in dollars, but they know that the difference exists. Recognizing that the general contractor is held responsible for the overall job, why shouldn't he be given the recognized right to negotiate with a better man?

All of us in the industry are against chiseling. When we call it negotiating, it perhaps doesn't fill us with such revulsion. There is a difference between the two, but sometimes it is difficult to determine just where the dividing line is.

If we should remove the onus of negotiation, we would at the same time remove the heavy downward pressure on prices. A contractor could bid what he considers to be a fair price, rather than submit the marginal bottom cost he feels must be put in to be low. Then, the select performers, the proven contractors, will feel that they can have a chance at the job after bidding.

A strong regulation of the list of general contractors who receive bids can weed out those who go in at cost and buy their profit by playing one subcontractor's bid against another.

So, in summation, there is some question that the mechanical contractors have improved their position. Credit is due and must be given for having made an intelligent try. Now let's see what happened after these rock-bottom price jobs are contracted. What then is occurring to the rest of the industry?

Where Does Jobber Stand?

The jobber has many problems. He knows that he is a recognized source of shelf items. In the area of boilers, compressors, heat transfer equipment, and other items shipped direct to the job, there is some question as to where the jobber stands.

If a contractor has no specific purchasing agent, the jobber can be of true service in handling a complete job. If there is a purchasing agent, the need for the shelf type items still exists.

The jobbing house thus remains a tremendously important and vitally fundamental element of our industry. Since it stands as the first material order recipient, it will be the logical one for our next in line examination.

It is quite understandable that contractors, having become saturated with an idea which is purported to be the salvation of their trade, will consciously or subconsciously apply their rule to their dealings with their suppliers. They must figure to the bottom dollar before the bid goes in. So if they must show their best hand first, they must do all within their power to induce their suppliers to do just the same. Accordingly, we find more and more contractors stating that the prices used in submitting their bid fix both the organization who will receive the order and the prices.

What does this do to the jobbing house organizations? The salesmen watch the market, feeling it out as to how much markup it will bear. Then in bidding the job, they mark it up just that, and probably as much less as the management will permit. Knowing that there is little chance of negotiation after the contract, they consider going in with a standard markup as being futile. As a result, the market keeps being pressed downward until the bottom is continually being scraped.

Just recently, a manager of a large heating supply house commented that his salesmen flinch everytime someone mentions price. They are gun-shy, and with good reason. A part of the close margin business in jobbing houses is due to the current trend toward harder competition and closer profit margins. The contractors, however, are encouraging this trend.

So we see the jobbers picking up the refrain of the low-man-gets-it theme. Somewhat battle scarred from its effect, he must look around for the next man and pass the banner on.

Agent Falls in Step

At the agent level, in addition to the downward pressures which are on the jobbing house, are two more factors. The air conditioning and hydronics fields are growing in new directions so rapidly that many old and new manufacturers are fighting for prominence in at least one of these directions. The other factor is the very obvious one of being one step further away from the ultimate consumer, therefore one additional chance at price attrition.

By the time a piece of the business reaches the agent, it may be pretty well hacked up. More than frequently, someone along the line —maybe the contractor, maybe the jobber—will have arbitrarily cut a little. It's bad enough as it is, what with the prevailing "low man gets it" theme. The going-in price has in all likelihood already presented a much lower figure than should normally be shown. The agent realizes, as does the

can upgrade prices by stressing customer relations"

jobber, that the contractor must have his best proposition at the very first.

So orders are quoted on the basis of the lowest acceptable price or, more often, to meet the market. Then, later, orders are taken and sent to manufacturers at these or even lower prices.

What Happens to Quality?

What becomes of quality in such a field of competition? The true color of the field of equipment productions becomes one of minimum quality to meet specifications. The manufacturer finds himself facing a design problem of not how to add to a product but how to cut his production cost, how to trim material requirements, how to produce something which is cheap and yet which will pass the comparison test.

By the time all of this is put together and the contractor is assembling his job, the engineer and the architect are feeling the pressures. These are also multi-directional. First, we overlook frequently an economic feature which militates against the design agency. When contracts are let at 10 to 15 percent less than they should cost, the income to the design agency suffers accordingly. Fees for professional design work are quite reasonably established, and that extra 10 to 15 percent gross income to a design organization can mean just as much as it does to any other business. So, at the outset, there is an additional burden on the engineering office, trying to turn out $1150 worth of work for $1000.

Next, to multiply his burden, when a job goes too cheap, he must watch it more closely to be sure that no compromises to the full measure of the contract occur. Many engineers feel that they are considered fair game by the contractors in this respect.

The low-man-gets-it philosophy of the contractors limits the engineer's ability to exert a selective influence on the choice of mechanical contractors. While he is not left helpless, he cannot ignore the community of interests as expressed by the mechanical contractors as a group. He knows that they have studied their problems and have arrived at conclusions which trend toward treatment as full equals, the small and the large contractors, the old and the new. He knows that public opinion pressures must influence his actions. It's just good business to go along with these pressures.

Not Much to Work With

The detail detective work required in reviewing submissions is the next problem. The contractor, the jobber, and the agent have all strained the specifications. The engineer must now examine most carefully the production of proposals, knowing that there is presented to him a hard business-like approach to the least expensive means of meeting the plan and specification intent. Most contractors have a shrewd knowledge as to just how far each engineer's specification can be stretched. So, the closer the profit, the greater the pressure at downgrading materials. The engineer must then patiently and thoroughly analyze, confer, reject, re-examine, listen to rebuttals, and at times find his opinions to be storm centers.

We have recently seen many signs of this stress. The base bid specification is a good indication of it, as is the resulting reaction of the engineer trying to reduce the stress.

The remainder of a job is much like the beginning to an engineer. If he has trouble at the start, he can look for continuing problems. A job at too low a price, to an inexperienced or inferior contractor, winds up with installation short-cuts, often with concealed errors, and frequently with difficult personalities to be handled. This means more engineering supervision requirement, or, if the engineer is not called adequately for this supervision, a job that fails to function as it should. So, it's more trouble to the engineer.

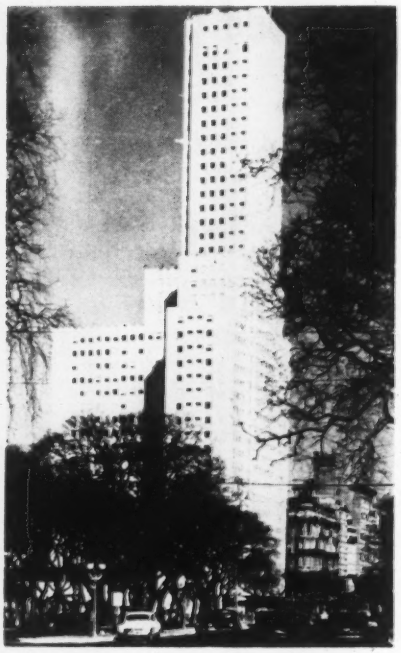
Build Customer's Confidence

The general unrest in our industry, the sparsity of profits, and the dissatisfaction are not due to just one cause. We have many problems. Answers may prove wrong. Actions are needed. And actions that may be remedial can have side effects which injure rather than help.

But if selling means creating the confidence of your customer in your ability to produce and to serve, we then need to sell. All of us, no matter which part of the game we play, can upgrade prices by stressing customer relations. If we can shed the cloak of price consciousness and approach each new job with a fair proposal and a willingness to negotiate with our friendly customers — forgetting those jobs which go to someone else's friend — we can start upgrading our industry.

Remember this: The low quotation, assuming it has distribution, does no one particular individual any favor. It only establishes the market level of the goods quoted for the given job. So what do you, the customer, owe to the man who put out that price? You don't owe him anything, unless he happens to be that lucky man with whom you wanted to do business from the beginning. ∓

Vertically Zoned Hot Water System Heats 40-Story Apartment Building



. . . solves problems of wind, stack effect

BY GEORGE T. LANG
Consulting Engineer

• Studies conducted during the design of the heating system for the Atlas Bldg., Buenos Aires' recently completed skyscraper apartment building, revealed that the 40-story structure would be best served by a system that would permit vertical zoning. Consequently, a forced circulation hot water system, with more than 1200 cast iron radiators recessed into exterior walls, was selected as the most effective way to provide for this zoning. The downfeed system delivers hot water horizontally above each zone and returns it via inverted return mains at the lowest level in that zone to establish a completely compensated hot water heating system.

Born in Budapest, Hungary, Mr. Lang received his mechanical engineering degree from the university there in 1934. He moved to Argentina in 1939 and has been engaged since then in heating and air conditioning work. In 1948 he formed his own consulting engineering office and has been responsible for the design of heating and air conditioning installations for a number of large buildings in Buenos Aires. He has also designed many industrial systems, especially for the textile industry.

THE NEW 40-story Atlas Bldg. in downtown Buenos Aires, Argentina, is the first skyscraper built in that city in many years, no tall buildings having been erected there since the middle 30's due to building code restrictions. Today, with the barriers relaxed, this structure is just one of several big jobs either under construction or in the planning stage.

The Atlas, with a total covered floor space of about 355,000 sq ft, houses 217 apartments with a net floor area of about 230,000 sq ft. Two large auditoriums and an entire floor which will be occupied by TV studios and offices will be air conditioned throughout. The two top floors will also be occupied by TV facilities and a meteorological station, leaving 38 floors for apartments.

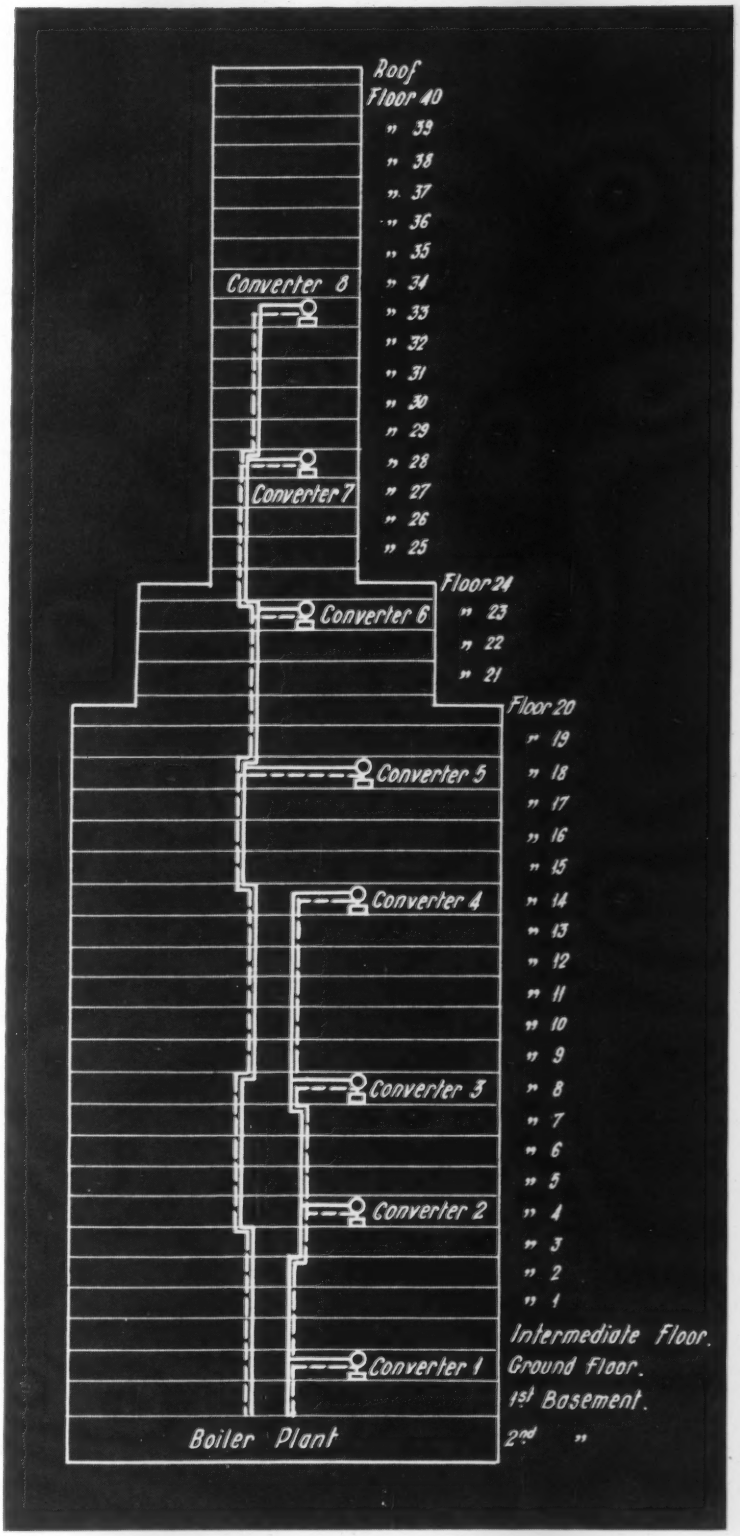
HEATING DESIGN problem for this new 40-story Buenos Aires skyscraper was compounded by impending variations in heating needs at different levels caused by predicted wind, stack effects

The building has an extended floor plan up to the 19th floor, an intermediate section comprising the 20th to 24th floors, and a tower with reduced floor area from the 25th to 40th floors.

Careful studies revealed the need for a heating system that would permit vertical zoning. Buildings surrounding the Atlas protect it against severe wind exposure up to about the 10th floor on two sides. Above this level it is exposed to wind on all four sides. In consequence, heating may be required at higher levels at times when very little or no heating is needed on the lower floors. This will depend on whether the wind effect or stack effect of the tall building will be predominant at any time.

Wind effect will require more heat for upper sections exposed to higher wind velocities, while stack effect may demand more heating on lower levels. In fact, stack effect can be very clearly appreciated in the tower section, where corridors seem rather overheated in spite of the fact that they are not heated at all.

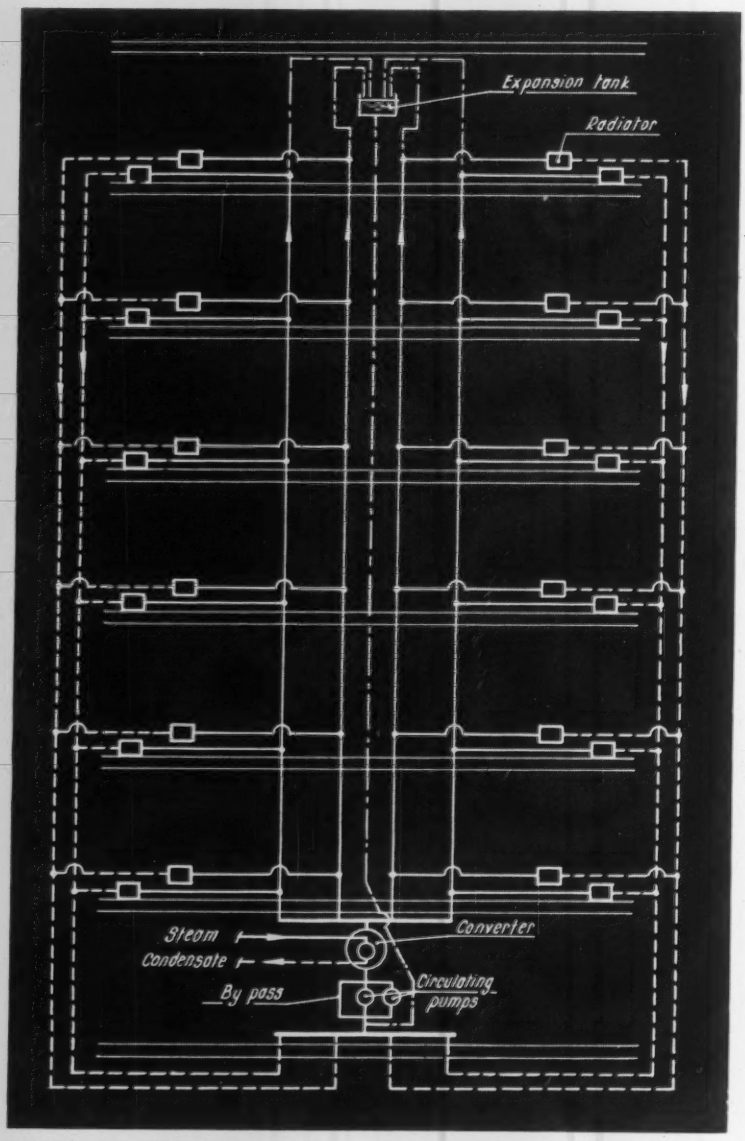
This is due to the stairwell being open from bottom to top and working as a vertical duct into which the warm air enters from the heated entrance hall on the ground floor or from intermediate floors when the doors to the stairwell are opened. To reduce this upward heat flow, all doors leading to the stairwell have automatic closing devices.



ATLAS BLDG. is subdivided into eight vertical zones, each having separate converter, circulating pumps. Zones are further divided into subzones according to exposure

Choose Forced Hot Water

Because of the need for vertical zoning, forced circulation hot wa-



DOWNFEED SYSTEM, besides being completely compensated for supply and return, has further advantage that each vertical zone has its supply and return mains on different levels, avoiding need for bigger ceiling spaces which could not be provided because of low ceiling heights

ter heating with cast iron direct radiating surfaces was selected. More than 1200 radiators are recessed into exterior walls and niches insulated with ½ in. insulating boards which eliminate about 5 percent of the heat losses.

On windy days the top floors have increased heat losses which have been taken into account by installing about 25 percent more radiation.

The building has been subdivided into eight vertical zones, each having a separate equipment room at a different level which houses a converter and circulating pumps. Zones are further subdivided into subzones according to exposure. Separate mains for each subzone are supplied by a common circulating pump.

The heating system is of the downfeed type. Supply mains for each subzone rise to the highest level of their respective zones. Horizontal distribution is above the zone, while return mains are at the lowest level of the zone. Inverted return mains, together with downfeed risers, equalize pipe friction for each radiator, thus establishing a completely compensated water distribution system.

Design Pays Off

In operation, the system has proved to be completely compensated, making any regulation by water flow restriction completely unnecessary.

During the past winter (summer, in the northern hemisphere), actual experience has confirmed the reasons for designing it with the eight separate zones. Operating results have been very satisfactory.

The boiler plant, comprised of four steel tubular low pressure boilers with a total capacity of about 14 million Btu per hr. supplies steam pressures up to 15 psi to hot water converters, domestic water heaters, and radiators in the main lobby which are steam heated.

Eight tanks with a total storage capacity of 7500 gal are installed in the boiler room and supply hot water to the main block of the building. Two tanks with 800 gal storage are installed on the 23rd floor to supply the upper part of the tower.

A Trend in the Making

The special interest of the Atlas Bldg.'s heating system is that it seems to mark the trend for the majority of skyscrapers now under construction or planning—at least in South America. Most of them will have vertically zoned hot water heating, although it will be largely panel heating with ceiling panels, which has gained great popularity lately in Buenos Aires. ∓

HOW TEMPERATURE, TREATMENT, AND VELOCITY OF POTABLE WATER AFFECT CORROSION OF COPPER AND COPPER ALLOYS

Monitoring System Reveals Effects Of Different Operating Conditions

● **Serious corrosion of the water distribution system at Michigan State University paved the way for extensive studies of the effects of different temperatures, velocities, and water qualities on the corrosion of copper and its alloys under actual field conditions. Jointly sponsored by MSU and the corrosion committee of the Copper and Brass Research Association, the program included an evaluation of the results of changes in water system operation. This article, the third in a series, describes how these systems were monitored by test units and field panels, and how test systems for studying pipe corrosion can be designed.**

BY MALVERN F. OBRECHT
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SEVERAL CONFERENCES between members of the Copper and Brass Research Association and staff members of Michigan State University about the serious corrosion noticed in the water distribution system at the University resulted in an extensive program of investigation and experimentation. The investigations involved a study of necessary changes in operating conditions to overcome the existing corrosion problem, to determine the actual magnitude of the problem, and to observe the effects of temperatures, velocities, and qualities of water on the corrosion of copper and copper alloys under field conditions. To take advantage of the ideal testing conditions, the studies were made at Michigan State.

This is the third in a series of articles. The first two appeared in the January and March issues.

One important phase of the investigation was the installation of a monitoring system to evaluate the results of changes made in operating the water distribution system as affecting the corrosion problem. As a matter of fact, the monitoring system employed is applicable to any piping system in which the extent and type of corrosion is being studied.

Three different types of testing devices were used for monitoring: (1) ASTM-NDHA corrosion test units, (2) strip testers, and (3) field panel tests.

The ASTM-NDHA and the strip testers served as monitoring devices and to supply preliminary quantitative data on the corrosion rates of copper, steel, and red brass at various temperatures, degrees of water hardness, and water velocities. Since any metal or alloy can be used in tests of this type, specimens of copper, steel, and red brass were used in this investigation because of their use in water distribution systems.

The advantage of using ASTM-NDHA testers or strip testers rather than field panel test loops is the ease with which they can be installed. On the other hand, the effect of velocities on corrosion can be studied more extensively in field panel test loops. The locations of the ASTM-NDHA and strip test units were chosen to provide as complete a coverage of the operating variables as possible.

"Hot" water temperatures were above 140 to 145 F, which is the approximate temperature at which a black oxide film rather than a basic copper carbonate film forms. The cold temperatures were the existing water temperatures encountered before the water was heated.

ASTM-NDHA test units or "testers" consisted of three copper or steel spirals separated by inert micarta (Fig. 1). The spirals are held in place by a steel frame connected to a 1 in. plug. The plug is then screwed in place in the line, with the frame holding the spirals well into the stream of water.

ASTM-NDHA testers are very easy to install, since it is only necessary to screw the 1 in. plugs into the prepared locations. Test units were installed in 12 hot water and five cold water lines.

Two Separate Sets of Testers Used

For this study, two separate sets of ASTM-NDHA testers were used. The first set was in place for approximately five months. The second was placed in previously used locations, but remained on stream for only 3 months.

Near the end of the period of testing for the second set, hydrated lime or soda ash treatment of the campus water was begun on an intermittent basis. In most of the buildings, forced hot water circulation was discontinued. The addition of lime to the water no doubt decreased its aggressiveness. The discontinuation of continuous circulation also tended to decrease the rate of corrosion.

As would be expected, the second set of ASTM-NDHA testers, in general, exhibited considerably lower corrosion rates than the first set. However, since the corrective measures of adding lime and discontinuing forced circulation were taken quite near the end of the test period of the second set of testers, it is possible that these measures alone are not the whole reason why the corrosion rates were lower in the second set. The fact that one set was tested during the summer and fall and the other set during the winter must also be considered as a possible explanation for the change in corrosion rates. Another factor which might prove very significant is the length of time of testing. It is possible that the corrosion rate increased with time in the case of the first set, thus giving an overall corrosion rate higher in that set. In other words, the possibility exists that corrosion rates increase as the extent of corrosion increases.

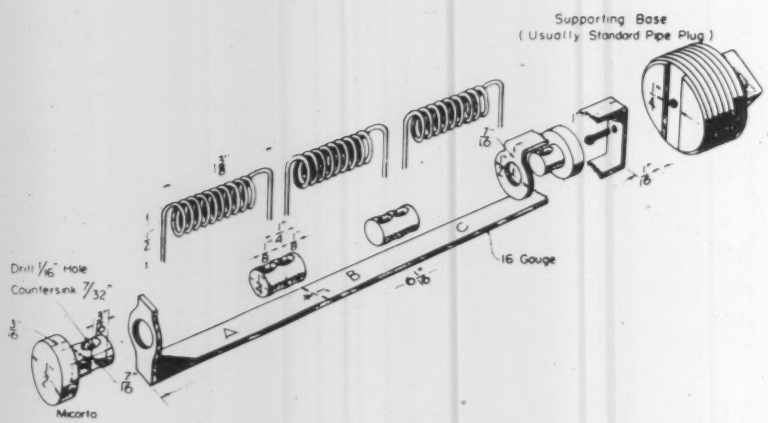
In evaluating test results, the spirals were weighed prior to installation and after the testing period. Before weighing the spirals at the end of a test, they were cleaned, according to the ASTM standards, in dilute inhibited acid to remove corrosion products. The difference between the two weights multiplied by a suitable conversion factor gave the rate of corrosion in mils penetration per year.

Corrosion Rates Differ

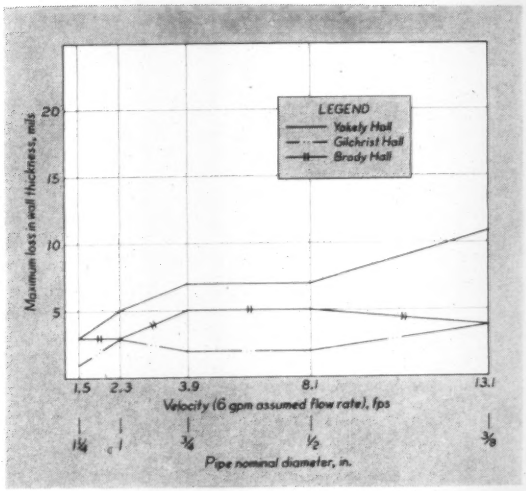
Higher corrosion rates were noted for the testers placed in hot, softened water under forced circulation compared to the testers placed in cold, unsoftened water under natural circulation. It is significant from the observations on these ASTM-NDHA testers that, in all locations where the corrosion rate of copper was very much higher than for steel, the temperature was above 140 F.

The second type of device used in the monitoring system was the strip tester. The same locations were used for the strip testers as for the ASTM-NDHA testers.

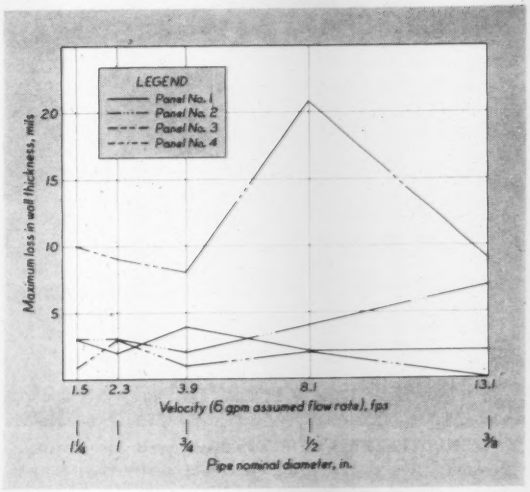
A strip tester is made by fastening parallel to each other a strip or coupon of phosphorized copper and of red brass of the same size ($\frac{1}{2} \times 3$ in.) at one end of a $\frac{1}{2}$ in. micarta rod. The strips were fastened so that $2\frac{1}{4}$ in. of their length extended out past the micarta rod. The other end of the micarta rod was screwed into the bottom of a 1 in. plug. The micarta rod was long enough that the strips were held well into a stream of running water.



1 EXPLODED VIEW shows breakdown of ASTM-NDHA test unit



Graph 1



Graph 2

MAXIMUM LOSS in wall thickness *vs* approximate water velocity plotted above for three field panel tests at student halls (Graph 1) and four panel tests at university's north reservoir (Graph 2)

Strip testers have the advantage over ASTM-NDHA testers in that they permit better observation of different types of corrosion and of the formation of protective films. Fig. 2 shows typical results of these strip testers after corrective changes were made.

All strips tested were on line for 96 days with the exception of one group of six that were in place for only 82 days. The strip testers, after removal from their various locations, were carefully examined for type of corrosion and type of film present. The strip testers were not used to determine corrosion rates, but they could have been used for that purpose merely by recording their weights before and after their insertion at the various test spots. All copper strips immersed in the hot water lines showed a deposit of a copper carbonate, except for those strips where impingement corrosion was quite evident.

Test Under Actual Operating Conditions

To obtain a more accurate picture under actual operating conditions, a third type of testing used field panels installed in several locations about the campus (Fig. 3). These panels were installed during the time the ASTM-NDHA test units were in use and consisted of a series of copper tube of various diameters connected by soldered unions. In all panels the tube sizes employed were ⅜, ½, ¾, 1, and 1¼ in. The panels were installed to permit water in the distribution system of the buildings in which they were located to flow through them.

Such panels provided means for testing and observing the corrosion of copper tube under actual operating conditions. Effects of two different velocities, both below and above that in the ¾ in. service line, were noted. This was accomplished by installing the test loops in a ¾ in. copper tube service line. Thus, two higher velocity tests were obtained (⅜ and ½ in. tubes), two lower velocity tests were obtained in the 1 in. tubes, and two lower velocity tests were obtained in the 1 in. and 1¼ in. tubes. These velocities were representative of conditions encountered in the ¾ in. service lines.

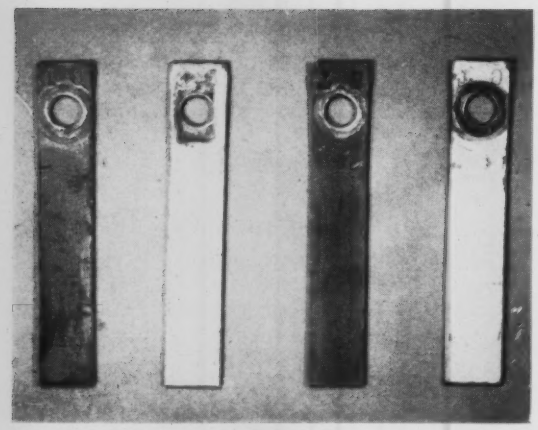
Field panels were installed in dormitories and service buildings in both the horizontal and vertical positions. Four were placed in cold water distribution systems.

The panels were run continuously except when they were disassembled about every three months for boroscopic inspection.

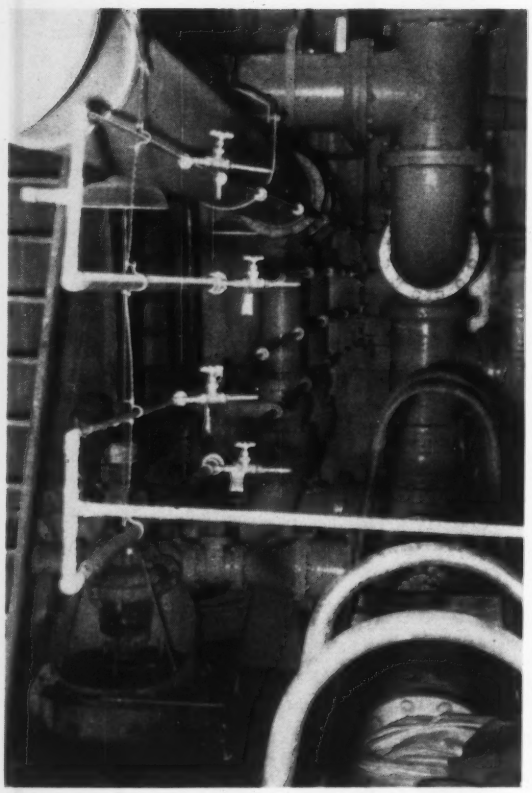
After nearly 1400 days, the field panels were removed from service. Final observations and evaluations are given in Table 1. The final boroscope observations indicated absence of severe attack and the build-up of a protective film on the tube surface.

To obtain a permanent record of all three of the testing devices, colored photographs were made of each ASTM-NDHA tester, strip tester, and sections from all tube sizes of each field panel. Figs. 2, 4, and 5 are black and white reproductions of samples. Such colored photographs allow accurate comparisons over various test periods in a given location. Typical results of wall loss thickness are given in Graphs 1 and 2.

The use of test panels and testers has proved to be a useful and practical means of evaluating the amount, rate, type, and seriousness of the corrosion. They also indicate the success of changing operating conditions, metals, etc., to reduce the corrosion in a system under study.



2 STRIP TESTER COUPONS were used for measuring corrosion rates and coating effects of corrective changes



3 FIELD PANEL TEST LOOPS for north reservoir consisted of four test sections with sampling valves at both ends of each section

Experimental pilot plants were designed to subject copper and its alloys to simulated field conditions of temperature, velocity, and water quality. An individual pilot test panel consisted of six vertical trains of tubing. Each train had five sections of Type L copper water tubing of decreasing diameters 1¼, 1, ¾, ½ and ⅜ in. The six trains, each operating at a different temperature, were connected in series by ¾ in. return lines. To permit easy disassembling for inspection, the sections were connected with unions.

Pilot plant test panels and a close-up of the thermally regulated heat exchangers for one test panel are illustrated in Figs. 6 and 7.

Tube sizes, operating temperatures, and water velocities for each panel were the same (Table 2). These conditions, along with the quality of water to be tested in each panel, were carefully selected in consultation with the corrosion committee of the Copper and Brass Research Association. The following observations and experiences were used as a basis for selecting the operating conditions:

1) It was not necessary to replace corroded tubes as frequently in the older campus distribution systems.

2) In some of the older buildings it appeared that the sodium zeolite softeners were run regularly beyond the point of exhaustion, flow rates were relatively low, and temperatures moderate with some protective films apparently having been built up on exposed copper surfaces under these conditions.

3) Newer installations appeared to have practically no protective film on the inside walls of the tubes.

4) In the newer systems occasional high chloride concentrations in the water were observed, indicating incomplete rinsing of the sodium zeolite softeners after regeneration.

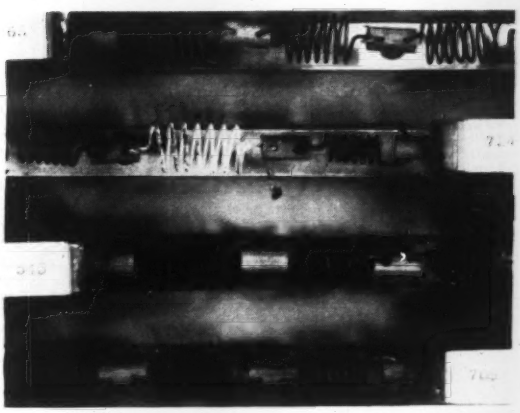
5) Temperatures in different hot water distribution systems were found to vary over a wide range, with a maximum temperature of 200 F in some.

6) Corrosion of tubes seemed to be most prevalent in locations where circulating systems were in operation, loads were heavy, temperatures were above 150 F, and softeners were regularly regenerated to maintain zero hardness at all times.

7) Visual examination of failed tubes almost always indicated pitting and impingement types of corrosion.

8) High concentrations of carbon dioxide and oxygen were found in the most aggressive waters.

The panels were designed so that circulating water would flow in the direction of decreasing tube diameter. The water flowing through each successive loop of a panel was heated to a temperature higher than that in the previous loop. The operating temperatures



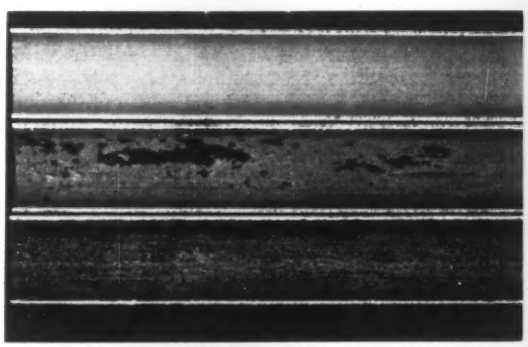
4 THESE ASTM-NDHA test units were removed after testing period and before cleaning. Note coatings

for the various loops were room temperature (50-70 F), 80, 110, 140, 170, and 200 F.

To minimize the effect of flow disturbances caused by the changing diameters, it was stipulated that no tube test section be less than 60 diameters in length. The flow rate was set at 6 gpm in order to obtain a velocity in the 1¼ in. tubing of 1.5 fps, which corresponds approximately to the minimum velocity for turbulent flow. Below this velocity, streamlined flow may exist and erosion-corrosion would therefore be at a minimum in this diameter tubing, since erosion-corrosion is caused primarily by turbulence. Corresponding velocities in the remaining sections are functions of their respective diameters.

Check Flow Rates, Temperature Daily

Daily checks were made of the flow rates and temperatures, with only occasional minor adjustments necessary. Samples of the water flowing through the various loops were taken at frequent intervals. These samples were then tested for alkalinity, hardness,



5 SECTIONS of tubes from field panel test after 1400 day test period revealed these protective coatings on tube surfaces

TABLE 1 — BOROSCOPE OBSERVATIONS of copper tube sections of field samples at final inspection after 1400-day test are commented on below

Location	Copper tube diameter, in.	Comments
Gilchrist Hall	⅜	Reddish brown crusty deposits. No velocity effect visible.
	½	Light brown deposit. Anodic areas scattered over surface. Appear where brown deposit seems to have bubbled and broken away leaving light green deposit visible.
	¾	Half of tube covered by brown deposit; other half shows dark background with speckled brown deposit over it. Small areas of green deposit visible as in ½ in. tube.
	1	Same as ¾ in.
	1¼	Same as ¾ in. except larger area covered with darker deposit.
Brody Hall	⅜	Light brown deposit, scattered, small islands of brown deposit over general deposits.
	½	Light brown deposit; dome shaped islands scattered over surface. Where several islands are grouped together, wall deposit becomes green and reddish brown. Where domes have fractured, buildup is seen to be light green.
	¾	Wall deposits are light green. Speckled with very small islands of brown deposit. Also a few thin grooves where green deposit has been gouged out. No metal visible.
	1	Same as ¾ in. except larger areas are covered by thin brown deposit.
	1¼	Light green deposit, small scattered bubbles over surface.
Yakeley Hall	⅜	Green deposits, bumpy surface, nodes topped with brown deposit. No pitting visible.
	½	Wall deposits green. Islands of brown deposit scattered over surface. Some long, thin islands also present almost in a line along one side.
	¾	Green deposits; some areas of light gray material visible where green deposit seems to have fractured. Some degree of roughness at outlet end. No real velocity effect apparent.
	1	Same green deposits; more surface covered with brown deposit over green. Area from cut edge to a line about ⅜ in. in from edge is completely covered with green-brown deposit. Other areas show more scattered coverage.
	1¼	Walls generally greenish-brown. Some rectangularly shaped areas have deposit missing and show gray green area beneath. No pitting visible; some roughness at downstream end.
Reservoir I	⅜	Flaky green deposit over brown deposit. Green deposit covering most of the wall at downsteam end becoming more scattered upstream.
	½	Same green deposit over brown deposit. Green deposit generally in large islands. Main area of island pale green, outer edges bright green.
	¾	Mostly covered with green deposit (varying shades). Brown deposit showing in scattered areas throughout. Large area of brown deposit at downstream end with some bright green deposits over.
	1	Generally covered with thin green and gray deposit (almost filmlike). Rust colored islands (deposits) running lengthwise scattered over ½ of tube arc
	1¼	Walls generally varying shades of green and gray. Rust colored deposits scattered throughout. Few larger islands of rust colored material. One island in center of tube running lengthwise is dark brown, oily looking — approximately 2 in. long. Green line approximately ⅜ in. wide runs length of tube.
Reservoir II	⅜	Reddish brown deposit over entire surface.
	½	Outer deposit is light brown material. Where brown deposit has fractured some areas have green deposit, others show dark brown film. Isolated anodic pits noted in dark areas, pits show shiny surface. Velocity effect noted by undercutting at pits.

chlorides, oxygen, carbon dioxide, pH, copper, iron, etc.

The panels were run continuously, except for interruptions at approximately four-month intervals when the trains were completely disassembled for inspection and study by the research committee. To avoid disturbing the deposits formed in the interior of the tubing, internal inspections were made with a boroscope.

The first two pilot plants were constructed of copper and red brass tube for testing sodium zeolite softened water. Other waters, which were utilized in later panels, were:

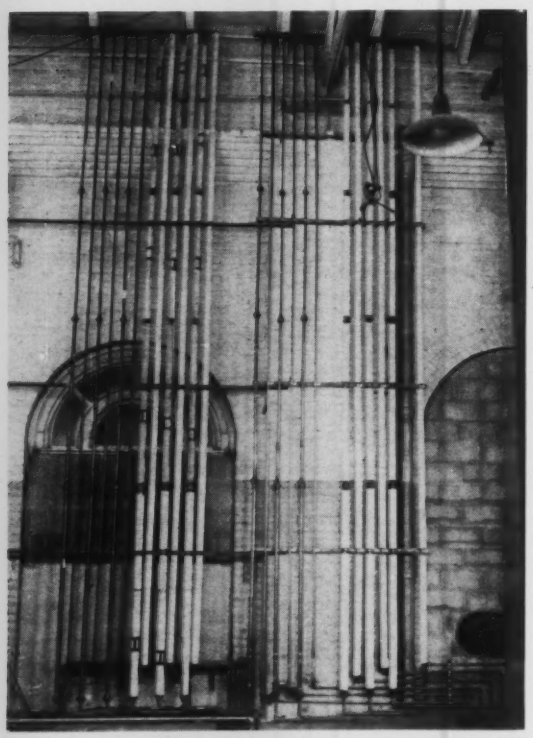
1) Lime soda softened

2) Lime soda softened followed by sodium zeolite softening

3) Sodium zeolite softened followed by cold vacuum deaeration

4) Blends of sodium zeolite softened and hard water to give a total hardness of 60 ppm or of 110 ppm.

One panel (MTP 7) consisted of sections of two different alloys. In MTP 7, equal lengths (30 diameters) of cupro-nickel and admiralty tubing are connected by a coupling and correspond to a total length of 60 diameters of copper tube in the other panels. This panel is testing sodium zeolite softened water. Table 3 lists the test panels utilized throughout the research program. The various panels are referred to as Main Test Panels (MTP) followed by the number of the panel.



6 TWO MAIN TEST PANELS shown. At left is copper panel; at right, red brass

TABLE 2 — SPECIFICATIONS for main test panel using Type L water tube are listed here

Nominal diameter, in.	1¼	1	¾	½	⅜
Nominal wall thickness, in.	0.055	0.050	0.045	0.040	0.035
Wall thickness tolerances, ±, in.	0.0045	0.0040	0.0040	0.0035	0.0035
Theoretical weight, lb per ft					
Copper	0.884	0.655	0.4550	0.285	0.198
Red Brass	0.865	0.641	0.445	0.279	0.194
Length of each test specimen, ft	6	5	4	3	2
Velocity at 6 gpm flow in specimen, fps	1.5	2.3	3.9	8.1	13.1

A more thorough description of each individual panel, as well as a discussion of the observations and results obtained from the tests, will be presented in future articles.

Each Panel Sectioned for Study

After the panels had been disassembled for the final time, each section was cut transversely into two equal lengths. The inlet section was saved for later observations. The outlet half was sectioned longitudinally; one section was used for studies of the deposits, the other for measuring the depth of pitting. A 6 in. length was cut off the latter sections and cleaned with an inhibited potassium chromate-sulfuric acid solution before being used for an evaluation of the extent of pitting.

The extent of corrosion was evaluated by micrometric wall thickness measurements, by loss of metal weight, and by radiographic studies of the first two panels.

Two sets of measurements with special micrometers were made on the wall thicknesses of the corroded tubing. One was made with vernier micrometer calipers fitted with special pointed contacts; measurements with this micrometer are termed "pointed micrometer measurements." A dial type of micrometer with special plate and pointed contact surfaces was employed to obtain "dial micrometer" readings. Measurements were made two ways: (1) by making 10 random readings longitudinally on each sample without regard to whether depths of pits or islands were being measured, and (2) by making numerous readings of pits and islands. "Pits" and "islands" indicate minimum and maximum remaining wall thicknesses.

Gravimetric or "loss of weight" methods to measure the amount of metal corroded away consisted of comparing the weights of suitably sized samples of corroded and original tubing. The results are expressed as "average wall thickness remaining." The average weights per unit length of both new and corroded tubing were determined on 3 in. lengths of

the tube, measured with a vernier caliper. All samples were weighed before and after cleaning in sulfuric acid-chromate solution. The average remaining wall thickness of the corroded samples was calculated by multiplying the nominal wall thickness by the ratio of the weight per unit length of the corroded tube to the weight per unit length of the new tube.

Try Special Radiographic Techniques

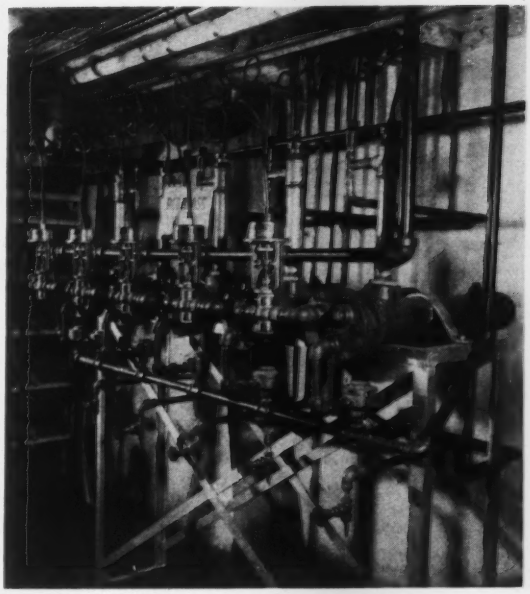
Another attempt to determine the amount of corrosion was accomplished by developing special radiographic techniques. Tube samples which had been cleaned were radiographed with molybdenum X-radiation. To permit measurements of wall thickness, a "step wedge" was photographed simultaneously with the tubing samples. The "step wedge" was prepared by milling steps of different thicknesses in a copper bar. The thickness of each step of the wedge was determined by micrometer measurements. Areas of more intense blackening of the developed film represent areas of deepest pitting. The intensity of blackening of the radiographs was obtained with a recording densitometer, using a point source of light. Readings were made longitudinally on both the wedge and the tubing specimens. The average remaining wall thickness of the copper tube determined in this manner will be referred to as radiographic data.

One method of reporting the results of a corrosion investigation of this type would be as gross loss of metal expressed as either metal wall thickness remaining or as depth or corrosion penetration. For either system, one must choose a reference on which to base the results. The reference could be taken as nominal wall thickness, plus or minus tolerances, or actual measured wall thickness of the tubing.

TABLE 3 — OPERATION TIME for test panels given here

Panel	Type of tube	Type of water tested	Total time in operation, days
MTP No. 1	Copper	Sodium-zeolite	498
MTP No. 2	Red brass	Sodium-zeolite	632
MTP No. 3	Copper	Lime-soda	324
MTP No. 4	Copper	Lime-soda Sodium-zeolite	324
MTP No. 5	Copper	Sodium-zeolite and deaerator O_2 1 ppm	498
MTP No. 6	Copper	Blended sodium-zeolite and hard 60 ppm $CaCO_3$	498
MTP No. 3A	Tubing from MTP No. 4	Blended hard and sodium-zeolite 110 ppm $CaCO_3$	498
MTP No. 7	Cupro-nickel and admiralty	Sodium-zeolite	498
Field panels			
Brody	Copper	Sodium-zeolite	1400
Reservoir	Copper	Sodium-zeolite	1400
Gilchrist	Copper	Sodium-zeolite	1400
Yakeley	Copper	Sodium-zeolite	1400

Note: Flow rate of all Main Test Panels was 6 gpm. Rates of field panels varied, depending on service demands.



7 THERMALLY-REGULATED heat exchangers for red brass main test panel are pictured above

It is the authors' belief that, for this type of investigation, both systems of reporting must be employed.

Evaluate Average, Maximum Losses

The data obtained from micrometric determination was evaluated both for average loss and maximum loss in wall thickness. Average loss was obtained by subtracting the average remaining wall thickness from the normal wall thickness in one case, and from the average measured wall thickness of new tube in the other. The average remaining wall thickness was obtained from the random micrometer readings. Maximum loss was obtained similarly by using the average of the "pit" micrometer readings. The data from the gravimetric and radiographic determination was used to obtain average loss in wall thickness, based on both nominal and measured wall thicknesses.

The data from each method was then plotted as maximum or average loss of wall thickness (based on both nominal and measured wall thickness of new tube) *vs* temperature, with velocity as the parameter. The same data was also plotted *vs* velocity, with temperature as the parameter. These graphs then indicated the critical nature of both temperature and velocity on the corrosion of the tube under test.

Articles to follow will show that this design was extremely satisfactory for studying the corrosive effects of various types of potable water on copper and copper alloys as a function of temperature and velocity. ∔

Design to Get the Most Out of Hot Water Heating

• Two main features of hot water heating are its ease of control and its heat storage potential. When called upon to design such a system, the consulting engineer must proceed with caution if he is to gain the full benefits of these advantages. Several of the design considerations that command his attention are detailed here. The author pinpoints particular items in the design of the zoned system and the compression tank and in the heating of air by hot water.

BY F. F. STEVENSON
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THE PURPOSE of my articles[1] on hot water heating has been to pinpoint a few items of interest in commercial and industrial hot water heating which, perhaps, are not in the category of generalities. As this series does not touch on residential heating, no mention has been made of radiant and baseboard systems which are now widely used in these fields. Neither does it deal with high temperature hot water heating, which is becoming increasingly accepted for large systems with long runs of piping.

Two advantages of hot water heating lie in its ease of control and its heat storage potential. It is possible, with proper valving, to vary the temperature of hot water in a heating system quite smoothly, with reasonably quick response to outdoor temperature changes. The inherent heat storage capacity of hot water also acts to smooth out the peaks and valleys in the control system. Water, in a radiator, loses heat slowly and can follow the demands of a thermostat readily. Hot water is now used widely as the heating medium in forced air coils, especially those with a limited temperature range.

This concluding section of the series of articles is meant to cover three phases of hot water heating: the zoned system, the compression tank, and the heating of air by hot water.

Zoned System Essential Where Loads Vary

A zoned system is essential if good control is desired in a number of areas where the heating loads vary at different times during the day. The variations are largely due to building exposure, but also may be caused by various internal heat gains created by electric motors, hot tanks, dryers, etc., with intermittent use.

To digress a moment, the story of troubles in a zoned air conditioned industrial building may not be amiss. The building is a large manufacturing plant having exterior and interior areas with widely different heating and cooling loads — especially in winter. In the interior parts of the building, the heat gain in summer from outside exposure was nil except on the top floor. But internal cooling loads were heavy and intermittent throughout the structure. In summer the design indoor temperature was 80 F at peak load and the coolant was air at 60 F — a 20 F difference.

[1] *Now's the Time to Brush Up on Your Hot Water Heating Fundamentals*, by F. F. Stevenson. Heating, Piping & Air Conditioning, September and October 1959.

Everything was fine in summer, but during the first winter troubles commenced. The heat gain in the interior was about the same in winter as in summer, so there was a cooling load when it was cold outside. But the design temperature in winter was 70 F, instead of 80 F. At 70 F, the temperature split was only 10 F, instead of the 20 F figure in summer. The air conditioning system, as set up, could not deliver air much cooler than 60 F, so it could not hold 70 F in these areas in winter.

So the complaints started pouring in. An indoor temperature of 80 F seems fine in summer when it is 95 F outside, but not so in winter. Major changes at heavy expense had to be made in the plant's air conditioning system to increase the air volume in the interior areas.

One might ask why cold outdoor air is not made use of in winter. Because the air would have to be 50 F or below to be useful and this scheme would require major changes in the air duct system. Also, it would leave a period of time during the spring and fall when the outdoor temperature was above 50 F and of no use.

Also, in the use of air much below 60 F, the designer should proceed with caution. Air at such temperatures may cause chilly drafts, especially with women workers. Too, condensation on duct walls and on surfaces adjacent to air supply outlets may become a problem.

Maintain Constant Hot Water Flow Rate

Hot water zoning is usually essential in commercial work. The best design is to use a three-way valve to mix supply and return water, with a separate pump for each zone. In this way a constant rate of flow is maintained, with variations in water temperature to suit the demands of the zone thermostat.

With this arrangement the water temperature off the boiler or converter can be regulated by an outdoor controller. If a plant has available steam, a converter is much better to supply hot water for a heating system than a boiler because of the ease of its modulating control. Also, with a system with higher pressure, converters are available to handle steam up to 125 psig, while the limit with a cast iron boiler is usually 30 psig.

Zoning can also be accomplished by using two-way valves to vary the flow of water. But this method is not desirable, especially where the zone circuits are large, because variations in water flow are much less desirable controlwise than variations in temperature. Individual control of radiators can be provided by self-contained modulating temperature regulators or manual valves. It should be noted that equal percentage valves (where flow varies as the square root of stem lift) are much better for the control of hot water than linear valves. Convectors can be controlled through the use of a two-speed fan. Remember, in control by regulation of flow, if one circuit gets less water, then more will usually tend to flow through the other circuits.

Figs. 1 and 2 show typical zone piping layouts. The system illustrated in Fig. 1 is piped so that the pump discharges *into* the converter and the one in Fig. 2 is drawing water *out of* the converter.

Fig. 1 also shows the compression tank located on the discharge side of the pump. This is satisfactory when the pumping pressure is not much higher than the system static pressure. If the pumping pressure materially exceeds the static pressure, the compression tank should be placed on the intake side of the pump, as shown in Fig. 2.

Two distinct pressures exist in a closed circuit hot water system when the pump is running: the total system static head and the pumping head. Considerable misapprehension exists with some engineers about the two pressures.

System Static Head Has Two Components

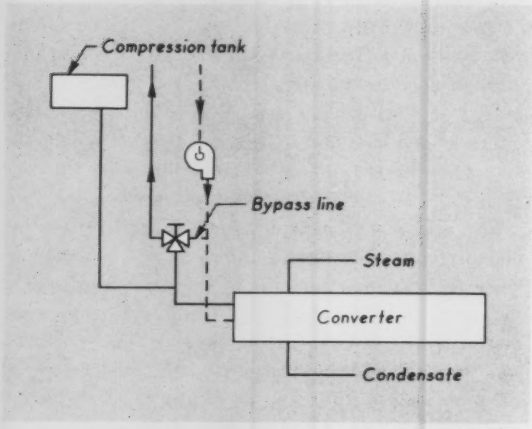
Assuming that all radiation is above the compression tank, the total system static head consists of two components: (1) the head when the water is cold and (2) the head when it is heated.

When the system is filled through a connected water supply line, it must have enough pressure behind it to rise to and fill the highest radiator. This pressure is reflected in the tank. At the start of filling, the tank is usually filled with air at atmospheric pressure. As filling proceeds, water flows into the tank occupying some of the space formerly filled with air. This increases the air pressure, which varies inversely with volume.

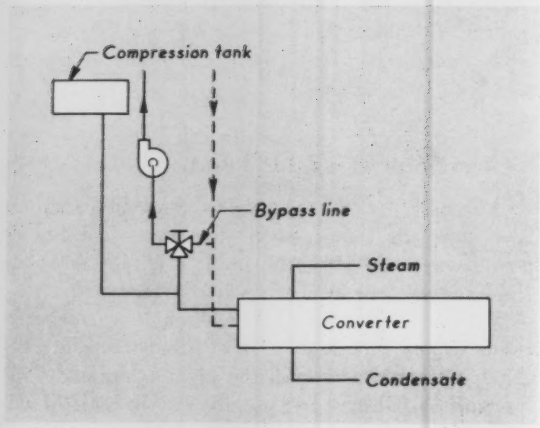
When the highest radiator is filled, the air pressure in the tank, when computed in feet of water, will be that corresponding with the height between the tank and radiator. Assuming a two-story commercial building, with the tank in the basement, the pressure head in the tank could be 15 ft WG. However, it is customary to allow some excess pressure to facilitate air venting, so more water is admitted to the system to increase the air pressure in the tank by 3 psig, or about 7 ft WG. Now the cold water static head of the system is 22 ft.

Many systems are filled through a pressure reducing valve set for 12 psig. If this is done, the static head will be about 28 psig. The higher the cold water static head, the larger the tank size. Why? Because, for a given tank volume, the higher the head, the higher the cold water level in the tank, leaving less room for water expansion.

Now, the water is heated, say, to 200 F, and it expands. This creates a flow into the tank, decreas-



1 TYPICAL LOW PUMP HEAD SYSTEM is piped so that pump discharges *into* converter. Mixing valve is hooked up to "fail safe," i.e., in event of air or motor failure, normally open middle port will continue to pass supply water through circuit while normally closed side will keep return water from flowing back into supply line



2 IF PUMPING PRESSURE materially exceeds static pressure, zone system should be piped so that pump draws *out of* converter. High pump head system is one in which differential is higher than static head at highest point in system

ing the air volume and increasing its pressure. Depending on the size of the tank, the total system static pressure might be 25 psig or 58 ft WG. With this pressure, the water could be heated to about 240 F without boiling. The higher the allowable total system static pressure, the smaller the tank size, because less room is needed for the air under higher pressure. The pressure reducing valve setting for filling should correspond to the system pressure at reduced temperatures (at night) or for operating temperatures, if the system runs 24 hrs per day.

When a heating system serves a building having many stories, the total system static head becomes quite high and compressed air is often used to keep the air cushion in the tank at a sufficiently high pressure.

It will be seen that the two pressures described above are the factors to check in sizing a tank when it is below the radiation. There are a number of other factors which also affect the tank size which are covered in the appropriate literature, but they are all minor in their effect and need not be discussed here.

Many tall buildings are zoned into, say, four floors per zone. A separate steam converter and tank is provided for each zone. In some cases, the tanks are open and placed above the radiation. An open expansion tank so located has a much lower pressure fluctuation range than a compression tank below the radiation.

Finally, it should be remembered that the total system static pressure has nothing to do with the pressure generated across the pump.

The pump develops enough pressure difference across itself to drive the water through the system at the required velocity, overcoming friction and dynamic resistance. Of course, the pump pressure, positive or negative, is imposed on the static head of the circuit, creating changes in the net pressure. It is advisable to place the compression tank on the suction side of the pump if the pump pressure head exceeds the system static pressure by very much.

This was discussed in my October article.

When the "point of no pressure change" is on the suction side of the pump, the pumping pressure is positive throughout the circuit, ending up with zero psig at the point where the pipe from the compression tank connects with the main circuit. If the tank is on the discharge side of the pump, the pump pressure is zero psig at that point. So pump pressure difference must be obtained by holding a negative pressure in the system relative to the pressure at the pump outlet, such negative pressure reaching its peak at the suction intake of the pump.

With this arrangement, it is apparent that if the pump pressure head exceeds the system static head by a large enough margin, the net pressure in that part of the circuit approaching the pump intake could easily be subatmospheric. For example, assume a system static pressure of 10 psig and a pump pressure difference requirement of 15 psig. On this basis, the net pressure at the pump suction intake will be −5 psig. In algebraic terms, the pumping pressure difference would be expressed by $10 - (-5) = 10 + 5 = 15$ psig difference. Operating at subatmospheric is harmful to the pump and the heating system, as was outlined in the previous article.

Use Cold or Hot Water Static Pressure?

The question has been raised: Which system static pressure should be used as a basis for these calculations, the cold or hot water static? The cold water static is, of course, less than the hot water and if it is used the danger of subatmospheric conditions is greater. Many systems start the pump for air venting purposes before the water is heated, so the need for the location of the tank on the suction side of the pump is more urgent if this is done.

If the pump is not started until the water is heated, then the system static pressure is much higher and the pressure difference developed by the pump would have to be very high to make a difference where the tank were located. To sum up, if the system static pressure is high, the location of the tank in relation to the pump becomes of smaller importance.

Note that the mixing valves shown in Figs. 1 and 2 are hooked up to be "fail safe," that is, in the event of air or motor failure, the normally open middle port will continue to pass supply water through the circuit while the normally closed side port will prevent return water from flowing back into the supply line. Also note the water fill line bypass permitting manual or automatic makeup water flow.

Mixing Valve Gives Best Control

For best control, a mixing valve (with two inlets and one outlet) is always better than a diverting or bypass valve (with one inlet and two outlets). Three-way valves are subjected to three pressures, usually all different. When sizing a mixing valve, be sure to check the *close-off* pressure. This term indicates the difference between the maximum inlet pressure of the inlet having the greater pressure and the outlet which is on downstream pressure. If the close-off pressure is too low, the valve will not close against the maximum inlet pressure.

Mixing valves are usually designed to be single-disc, double-seat. Some diverting valves also have this design, but it is much better to use a diverting valve made with two discs, especially for modulating service.

When there is considerable difference in the three pressures, the reversal of single-disc travel up and down between the upper and lower seats is likely to be very rapid. This instantaneous reversal of travel may overcome the resistance of the bellows and spring of the pneumatic valve operator and the disc will slam against the seat and cause water hammer. A double-disc diverting valve may alleviate this trouble, but it is better to use a diverting valve only for *on-off* service.

When outdoor control is used, the ratio of water temperature change to outdoor temperature change must be defined. Most of these controls may now be adjusted for different ratios in the field. For commercial and industrial work with a converter, a one-to-one ratio is often used, as follows, where the water temperature range is 80 F:

Outdoor temperature, F	Hot water temperature, F
−10	220 F
0	210
10	200
20	190
30	180
40	170
50	160
60	150
70	140

Don't Set Lower Temperature Range Too Low

To maintain a lower water temperature range, with higher water temperatures, a 1-to-¾ range can be used. This gives a low water temperature of 160 F and a total water range of 60 F. Systems using boilers fired by oil or gas should not have the lower range of water temperatures too low. This results in a low boiler firing rate with considerable amounts of water vapor in the products of combustion which are deleterious to chimneys and stacks. There are a number of proprietary outdoor controls now in use with at least one being able to compensate for wind velocity.

Hot water is now widely used for heating air. Many of the "ready made" heating and ventilating units are equipped with coils for hot water and such

coils are commonly used in larger central fan stations.

The basic reasons for this trend have been noted in the first part of this article. In forced warm air systems, hot water coils are being used more widely for preheat and reheat work where the temperature range is low. In this service, temperature overruns may be experienced with steam, even though two pairs of coil dampers are used. With hot water, moderate temperatures can be held without the use of two pairs of coil dampers.

In summer reheat work, for instance, with ranges of from 5 to 15 F, hot water is just the thing. True, hot water from a converter requires two heat exchanges, but the aforementioned advantages justify the expense of the extra exchange. In the use of water coils for heating air, the internal film heat transfer at 4 fps is a bit lower than for condensing steam, but the external (air) film transfer is the controlling factor.

Use Mixing Valve to Vary Temperature

Control valving for hot water coils is best done with three-way mixing valves. But the method should be different than that commonly used for chilled water. For the latter, standard practice has been to use a mixing valve at the coil to regulate the volume of water and not the temperature. This is all right for average chilled water systems, where perhaps there is only one coil in a system and the temperature change in the water is low.

But with many hot water coils, the temperature drop may be higher than the rise in chilled water systems. So it is preferred to maintain the flow through the coil and use the mixing valve to vary the temperature. Also, for reasons to follow, throttling valves may not give good control with moderate to light loads.

Some systems use a single pump when there are several coil circuits. This may make control difficult at light loads when one or two coils are *off* with a similar number *on*. The "mixing" flow with this hookup comes from a return line common to all the coils. The coils which are *off* do not use any water from the supply line, but receive 100 percent return water. If there is only a 10 to 15 F drop through the coils which are *on*, the return line water could be 180 F or more, depending on the initial supply temperature. Thus, the coils which are supposed to be *off* are still receiving hot water and nothing can be done about it. When a separate pump is used for each coil, the mixing is done by the coil's own return water, so the above difficulty is eliminated.

Two-way throttling valves are not too efficient for hot water coils. Under moderate loads, reducing the flow does not afford satisfactory control. It has been shown that heat output is not a linear function of flow. When a valve is positioned for 50 percent of flow, the heat emission is only reduced by a small amount. With low water velocity, its passage through the coil takes much longer and its temperature drop is much greater. This, of course, tends to keep the heat emission still at a high level. If two way valves are used, an equal percentage type of valve should be selected.

It is well known that a high water temperature drop across the coil is advantageous to throttling valve operation. A high pressure drop across the valve is also beneficial for control. It makes the drop across the valve the principal loss in the circuit and the valve has a smoother action.

How to Avoid Water Coil Freeze-Ups

Finally a suggestion or two to avoid water coil freeze-ups: When outside air is used with a forced air coil, either 100 percent or in a mixture with return air, there is always a chance of freezing. This is especially true when the flow is throttled, reducing the velocity and tending to make the water stagnant in the coil.

The best protection against freezing is, of course, to use a solution of 40 to 50 percent antifreeze, such as ethylene glycol. Remember, however, that the heat transfer rate of such a solution is materially less than with straight water. This must be allowed for in sizing converters and coils. Also, antifreeze increases the coefficient of thermal expansion, requiring larger compression tanks.

Other protection tips: Some designers use face and bypass dampers at the coils for modulation, with a two-position *(on-off)* water valve. Do not use too long a coil when exposed to freezing air. Keep the water velocity up. When draining coils using plain water and where they will be in contact with outside air, be sure the drainage is 100 percent.

There were a few comments about the treatment of pressure reducing valves and relief valves in the previous articles. A standard setting of a pressure reducing valve is 12 psig, or about 28 ft WG. This means that the valve will open at any pressure less than this with the pump *off*. For average installations this is satisfactory.

The standard relief valve setting is 30 psig. This is derived from the fact that the pressure limit for cast iron boilers is 30 psig. This setting corresponds to 69 ft WG and the water temperature could rise to 250 F without boiling. With a pump having a head of 10 psig, or 23 ft WG, and a system static pressure of 28 ft WG, as mentioned above, the total pressure with the pump running would be 51 ft WG. This corresponds fairly well with the relief valve setting of 30 psig. ∓

Tests Compare Heat Transfer Of 5 Cooling Tower Packings

• **Tests with five cooling tower packing materials — aluminum, redwood, foamed plastic, cement asbestos board, and smooth acrylic plastic — have shown measurable differences in heat transfer characteristics. These are attributed to the amount of splash area caused by each material. Herein is a study of these tests, which were conducted by the Texas Engineering Experiment Station.**

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Texas Engineering Experiment Station

UP TO a certain point, improvement in a product or an item of equipment is relatively easy and evolves almost without effort as the result of simple observations and random experimentation. Eventually, however, the stage is reached at which either a fundamental understanding of the most minute details of the phenomena must exist, or the results of carefully designed experiments must be accurately analyzed and studied with the overall picture in view.

A critical study of the fundamentals of fluid flow and of mass and heat transfer and their effects in the analysis of cooling tower performance is pointing toward changes in configuration and materials. Undoubtedly, product improvement will result. Also, many detailed experiments conceived specifically to determine coefficients for precise evaluation are being undertaken with significant improvement in the ability of the engineer to accurately predict cooling tower performance levels.

The Texas Engineering Experiment Station performed several hundred carefully designed tests on a variety of packing materials and shapes in an effort to develop a rational approach to cooling tower packing design. The performance tests were conducted with different types of packing materials to determine the effect of packing material, or surface condition, on the heat transfer and pressure drop characteristics. Results for packing slats constructed from each of five different materials are presented in this article. The materials are aluminum, redwood, foamed plastic, cement asbestos board, and smooth acrylic plastic.

The equipment consisted of a counterflow, forced draft cooling tower constructed from 16 gage gal-

TESTS YIELDED THREE MAJOR CONCLUSIONS

Three main conclusions were made from the comparative tests:

1) Measurable differences in heat transfer characteristics exist for the various types of materials studied.

2) The differences in heat transfer characteristics were attributed to the amount of splash surface area caused by each type of packing. It is possible that the harder, smooth-surfaced materials possess a characteristic much like resilience which enables more of the kinetic energy of the falling water to be useful in forming fine particles and mist, the effect of which would be an increase in the total surface area and heat transfer. A possible explanation for the lower than predicted heat transfer obtained from the foamed plastic is that the energy from the falling drops was dissipated in random directions or in overcoming frictional forces upon striking the rough surfaces which would decrease the amount of splash area produced by the packing.

The selection of materials was far from inclusive and additional tests should be made to verify or disprove the results obtained and to discover the mechanism.

3) No definite change in pressure drop due to the material of construction of the packing and the slight change in the projected areas could be detected in the data. The average pressure drop through the tower was 0.015 in. water gage per foot of packing height with an air rate of 1500 lb per hr per sq ft.

vanized sheet metal formed into interchangeable sections each 2 ft in cross-section and 3 ft high. The sections can be arranged to test packing heights of 3, 6, or 9 ft. A flume type of gravity water distributor was used with the tower.

Provisions were made for varying the water and air flow rates through wide ranges and for controlling the flow rates within approximately ±1 percent. The temperature of the water entering the tower was controlled within ±0.1 F of the desired temperature for most operating conditions. The wet bulb temperature of the air entering the tower was controlled within ±0.2 F of the desired temperature. The tower was operated at entering air temperatures above those of ambient air, since no provision was made for controlling the wet or dry bulb temperature below that of the ambient air.

Air entering the tower flowed through a duct equipped with steam humidifiers for control of the wet bulb temperature, then through an ASME nozzle for flow rate measurement, through the blower, and into a large plenum chamber. The air then was directed upward through the packed tower and exhausted outdoors.

Air pressure drop across the packed section of the tower was determined by direct measurement of the pressure differential from the large plenum chamber to a small plenum chamber placed directly above the packed sections.

The circulating water flowed by gravity from a sump located in the bottom of the plenum chamber to a centrifugal pump, then through a steam heated heat exchanger. Heated water passed through sharp-edged orifice plates and returned to the tower through the water distributor section. The orifice plates were calibrated in place prior to operation of the tower.

A multiple-channel, recording, resistance bulb thermometer was used to indicate steady state conditions in the tower before data was taken. All temperature observations were made with calibrated, mercury-in-glass thermometers.

How Tests Were Conducted

Packing slats of nominal 3/8 in. × 1 in. cross-section were constructed from each of the following materials: (1) smooth extruded aluminum bar stock, (2) rough-cut redwood, (3) rough surfaced foam plastic, (4) cement asbestos board with a relatively smooth, porous, easily wetted surface, and (5) acrylic plastic, with a smooth, glasslike surface.

Tests were conducted on each of the materials by placing the slats in sheet metal packing supports designed to support the slats on edge. The horizontal spacing between adjacent slats was 1 1/8 in. center to center, while the vertical spacing was 6 in. between decks.

Each deck was rotated 90 deg horizontally from the deck immediately below. Performance tests were conducted on 6 ft heights of each material by using two of the packing supports attached to the inside of two of the tower sections.

The air flow rate was maintained constant at 1500 lb per hr per sq ft of tower area during all tests. Performance tests were conducted on each type of material with water flow rates of 750, 1500, and 2250 lb per hr per sq ft of tower area. Inlet air wet bulb temperature was controlled at 80 F and inlet water temperature at 105 F.

Values of KaV/L were calculated from data using the common equation for counterflow cooling towers[1]:

$$\frac{KaV}{L} = \int_{T_2}^{T_1} \frac{dT}{h'' - h_a}$$

where:

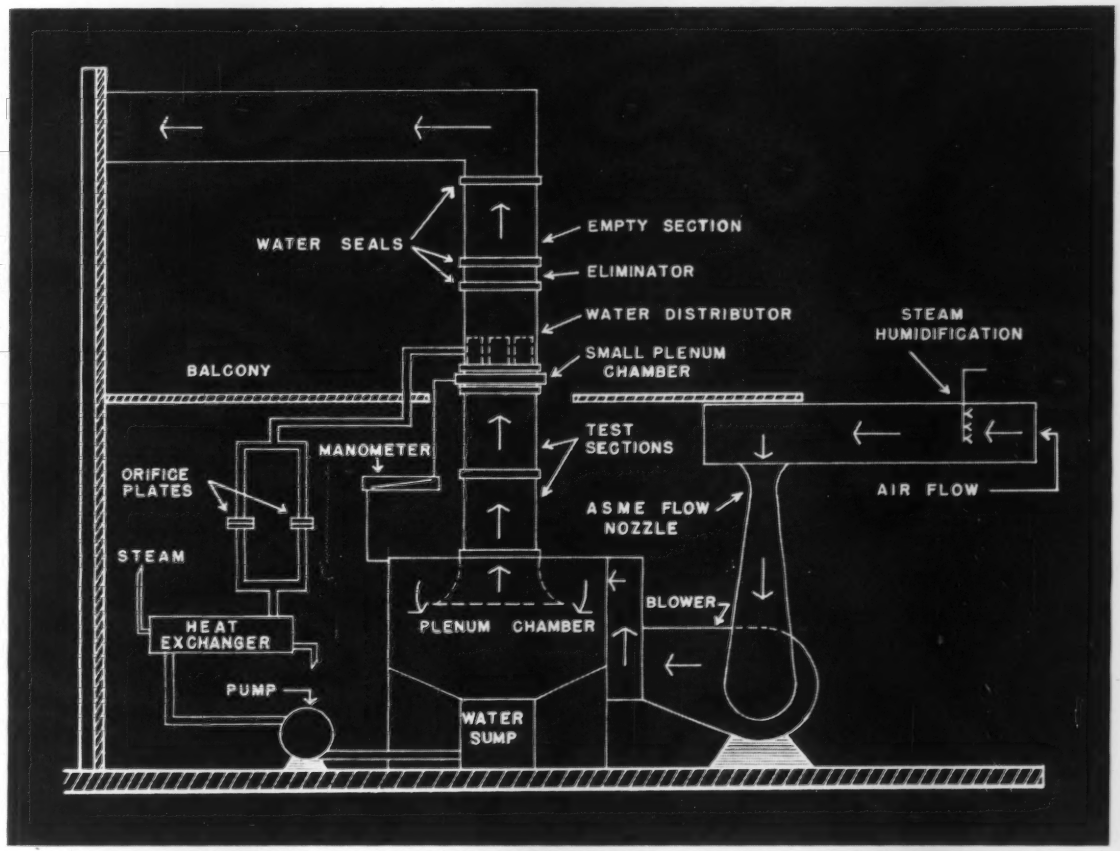
K = overall energy conductance, Btu per hr per sq ft overall average wetted area per Btu enthalpy difference per lb of dry air
a = overall average wetted area (surface of water drops plus wetted tower surface), sq ft per cu ft of active tower volume
V = active tower volume, cu ft
T_1 = temperature of inlet water, F
T_2 = temperature of outlet water, F
T = temperature of water in tower, F
h'' = enthalpy of saturated air-vapor mixture at water temperature, Btu per lb of dry air
h_a = enthalpy of air-vapor mixture, Btu per lb of dry air
G = air rate, lb of dry air per hr per sq ft of tower ground area
L = water rate, lb of water per hr per sq ft of tower ground area.

Characteristic curves showing KaV/L as a function of the liquid to gas ratio were plotted for the 6 ft heights of each material. The values of KaV/L, at an L/G of 1.0, for the 6-ft packing heights were used

TABLE 1 — PACKING DIMENSIONS, TEST RESULTS are given below

Material	Slat width, in.	Slat height, in.	M (width/height)	$M^{0.2}$	Projected area, sq in. per deck*	Projected area/$M^{0.2}$	Projected area/$M^{0.2}$/229	KaV/L at L/G = 1.0 for 6 ft height: Predicted	KaV/L at L/G = 1.0 for 6 ft height: Measured	Percent deviation in KaV/L of measured value from predicted
Acrylic resin	0.357	1.009	0.354	0.812	178.1	219	0.956	0.880	0.99	+13
Aluminum	0.372	0.996	0.374	0.822	185.5	226	0.987	0.908	0.98	+ 8
Cement asbestos	0.381	1.002	0.380	0.824	190.0	231	1.009	0.928	0.94	+ 1
Redwood	0.376	1.025	0.367	0.818	187.5**	229	1.000	0.920	0.92	0**
Foamed plastic	0.393	1.049	0.375	0.822	196.0	238	1.039	0.956	0.91	− 5

* 21 slats per deck, 23.75 in. in length.
** Projected area assumed as a standard.



SCHEMATIC ARRANGEMENT of forced draft counterflow cooling tower used for testing packing materials is shown

as a basis for comparing the different packings.

The measured values of KaV/L at an L/G of 1.0 varied from 0.91 to 0.99. The results were at first considered to be inconclusive, reflecting little more than experimental error and the slight differences in the cross-sections. However, further study indicated that a more careful analysis of the data should be made. This conclusion resulted from the observation that the larger heat transfer rates appeared to be associated with the harder, smoother surfaced materials, although the measured cross-sections of these materials were, in general, smaller than the cross-sections of the more porous materials, such as redwood and foam plastic.

Any differences in heat transfer rates not explained by differences in the slat dimensions were originally thought to be due to the ability of the packing material surface to absorb or to be wetted by the water, which should produce a more uniform film surface. The results, however, were to the contrary. The following revaluation procedure was used.

The projected area and the measured value of KaV/L of the redwood packing were chosen as a standard for comparison. Adjustments were made in the values of KaV/L for the other packing materials on the basis that the heat transfer characteristics, for small changes in the element cross-section could be adequately represented as a linear function of the projected area. The heat transfer characteristics were found to vary inversely as $M^{0.2}$, where M is the width to height ratio of the rectangular cross-section[2]. The predicted value of KaV/L calculated for the acrylic resin by this method was:

$$\text{Predicted } KaV/L = (178.1/187.5)\ (0.818/0.812)\ (0.920) = 0.880$$

compared to 0.99 as measured. Table 1 gives pertinent information including packing dimensions, $M^{0.2}$, and the percent deviation of the measured values of KaV/L from those predicted.

It was found that the measured values of KaV/L for the acrylic plastic, aluminum bars, and cement asbestos were 0.11, 0.07, and 0.01 units higher, respectively, than the predicted or adjusted values, and that the measured value of KaV/L for the foam plastic was 0.05 units lower than predicted. ≠

[1]Heating, Ventilating, Air Conditioning Guide, p. 583, 1959.
[2]*Study of Three Redwood Cooling Tower Packings*, by Wesley W. Smith. Heating, Piping & Air Conditioning, July 1956.

THROUGH AIR CONDITIONING, garment workers' efficiency and morale are increased. Year 'round stabilized production rate, with no seasonal slowdown during hot summer months, means more dollars to manufacturer, employee alike

Garment Plant Cooled By 4 Packaged Units

BY J. W. ORR
Air Conditioning Div.
Westinghouse Electric Corp.

AN EXCELLENT example of the application of packaged air conditioning units for industrial comfort cooling can be found in the recently constructed Stately Lady Nite-Wear, Inc. plant in Charlotte, N.C. Leasing the newly constructed building on a long-term basis, the company recognized the advantages of employee comfort cooling.

A manufacturer of ladies' nightwear garments, Stately Lady considered proposals of both the built-up system and the packaged unit approaches to comfort cooling, as presented by the consulting engineers. The latter plan was selected as the more practical answer to its particular needs.

The plant building with single-story, flat roof, slab floor design, has brick veneer and concrete block walls and a precast concrete roof slab with built-up decking. The flow of manufactured materials is through the pattern cutting, sewing, packaging, and shipping operations. Due to the relatively close work required in the garment sewing operation, employee comfort is quite essential for a high production rate with a minimum of product rejects.

Leasing a new plant, ladies' wear manufacturer invests in flexible, economical air conditioning system which boosts production output

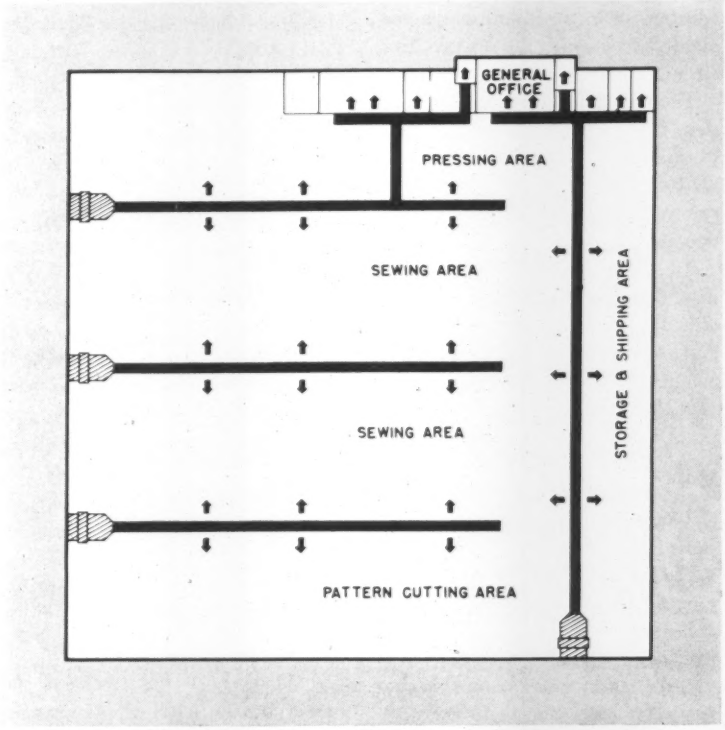
Three of the four 40 ton packaged units used are spaced inside the building along an exterior wall. Each is 41½ ft from the outside wall to permit rear return air and a close tie-in with an outside wall louver for outdoor air.

The units discharge vertically into a supply duct suspended from the precast slab roof and extending the length of the building. A branch duct of one unit supplies conditioned air to a portion of the general office space.

The electrical center for each unit is located on the adjacent wall, with a two-step cooling thermostat and single-step heating thermostat located on a vertical column in the zone being served. A cooling tower is located on the roof above each unit. Gas-fired duct heaters are suspended from the roof and located in the supply duct.

The fourth air conditioning unit, located at the far end of the building, serves the storage and shipping area and the general office space. To conserve cost involved in multiple equipment rooms, the unit, electrical control center, and cooling tower pump are located within the manufacturing area. Later, enclosure through wall partitioning can be accomplished easily.

The layout of the four units permits operation of one or more of them for zone or mild weather cooling as the use of plant space requires.



FOUR PACKAGED UNITS deliver conditioned air to plant via supply ducts suspended from ceiling. Note that two units are ducted to serve office areas

Discharge Blanket of Air

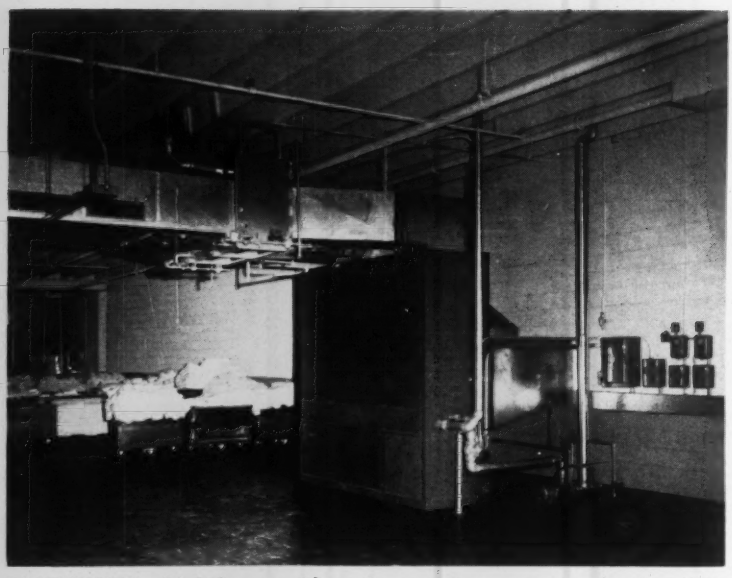
Since employee comfort was the prime design consideration, an overhead suspended supply duct system was installed to blanket the manufacturing area with conditioned air. The supply duct is constructed of 24 gage galvanized and stepped-down in a reduced plenum design, with the bottom of the duct 9 ft, 8 in. from the floor. Most of the manufacturing space is utilized by the garment sewing operation and did not require any special "spot" cooling consideration in planning the air distribution.

A double-deflection supply outlet design is used. Outlets are mounted near the bottom of the duct and opposed to each other for better air distribution. Each outlet is mounted on a 3 in. collar, and can easily slide vertically out of collar slots for periodic lint cleaning. Louvers are set to concentrate on the floor-to-8-ft air layer.

The supply duct goosenecks off the air conditioning unit with air turning vanes and is canvas collared to isolate cabinet vibration.

Branch ducts off the main supply duct of two of the four units supply conditioned air to the general office space. Had any appreciable nighttime use of the office area been anticipated, a separate small packaged unit would have been installed to handle this space independently.

Return from the general office area is through low door grilles to the manufacturing area. Return air from the conditioned space is brought to the unit through a re-



EACH UNIT is 4½ ft from outside wall to permit rear return and a close tie-in with outside wall louver for outdoor air. Natural gas fired heaters are incorporated in supply ducts for winter heating

turn air plenum in the rear of each unit. The return plenum is designed to accommodate from zero up to 100 percent outside air operation, and utilizes an inverted "V" recirculated air intake on top of the plenum.

The galvanized screen covering the recirculated air intake opening is covered with a fine mesh plastic cloth. In handling, cutting and sewing cotton cloth materials, both a fine lint and a starch "fly" become airborne. The fine mesh cloth collects this as the air enters the intake opening of the plenum, cutting down the frequency of filter changes to once every three to four weeks. The plastic cloth is wiped clean daily. Arrangement of the return air plenum is such that an automatic method of filtering can be installed at a later date if desired.

The return air plenum is connected directly to a screened louver in the outside wall of the building for intake of outdoor air for ventilation and mild weather cooling. The outside intake is sized to handle 100 percent unit air delivery. Air flow through both the return and outside air intake openings is controlled by single-acting dampers. Both dampers are manually adjusted to proportion recirculated and outside air, but can be easily automated later on by the addition of a positioning damper motor tied in with the unit control circuit.

The entire return air plenum is shop fabricated, with 1 in. of glass fiber insulation and an inside galvanized liner soldered airtight to prevent condensation of the humid outside air.

The filter bank of each air conditioning unit utilizes 2-in. cleanable type aluminum mesh filters, and is located in the rear of the cabinet, accessible from a side access slot.

How Units Are Controlled

The electrical center for each unit is located on the adjacent wall. Job specifications called for part-winding starting for the 220-volt, 60-cycle, three-phase compressors, with fused disconnects for the compressor and fan motors installed adjacent to the unit.

Each unit is controlled from a two-step line voltage cooling thermostat mounted on a vertical column in each of the zones. The two-step thermostat controls the compressor cylinder unloaders to give 50 and 100 percent capacity operation, and automatic 100 percent unloaded starting. A manual toggle switch is used to provide fan ventilation without refrigeration during mild weather.

Operation of the gas fired duct heaters is controlled through a separate single-step line voltage heating thermostat mounted adjacent to the cooling thermostat. The heating thermostat is wired through an auxiliary contact on the air conditioning unit fan motor starter to assure operation of the fan before the thermostat will start the natural gas heaters. The fan is wired for continuous operation during heating and cooling.

Each Unit Has Cooling Tower

Each air conditioning unit utilizes a 40 ton forced draft cooling tower located directly above on the flat roof. The water-cooled condenser is internally circuited for cooling tower operation. The cooling tower water circulating pump is installed on the concrete floor adjacent to the air conditioner, and draws from the cooling tower sump and discharges into the unit water cooled condenser. A bypass is installed across the condenser to permit regulation of the condensing water rate. A plug cock in the pump discharge line permits adjustment of the pump head to further regulate the condenser water rate.

Multiple 40 ton towers are used instead of a single central tower to reduce the roof weight loading and to capitalize on competitive pricing practice in the smaller towers. Each tower is located 12 in. from the exterior wall and directly over a wall column for bearing. Tower selection was made on the basis of maintaining a maximum of 85 F entering water temperature to the condenser.

Condensate piping for each unit drains into a nearby floor drain.

Unit Heaters Supply Heating

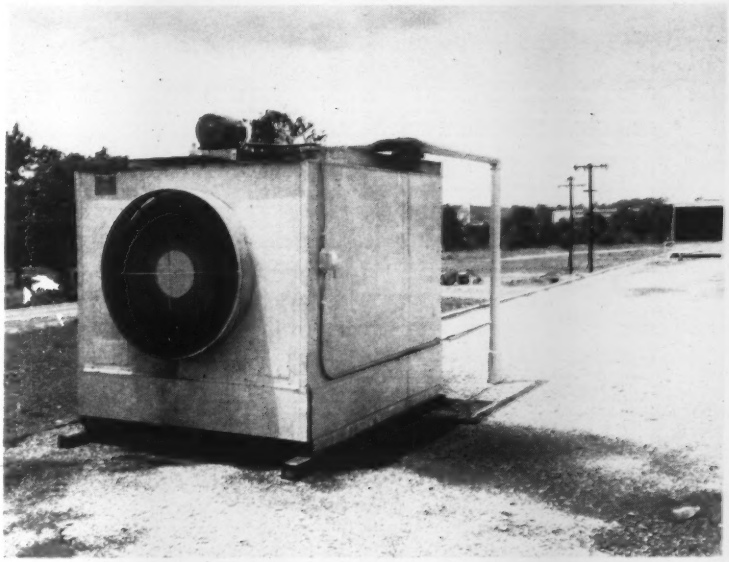
Winter heating is supplied by 250,000 Btu per hr input gas fired duct heaters in the supply duct of each air conditioning unit. The heaters are suspended from the roof slab with the flue pipe extending through a sleeve in the roof and capped with an anti-backdraft vent cap.

The supply duct connection to the duct heaters includes an air bypass around the heating section to retain the required air temperature rise across the heat exchanger. Air bypass is controlled by a manual single-acting damper. Access doors in the bottom of the duct on both sides of the duct heater provide access to the heat exchanger for inspection and service. Heating control is accomplished by use of a line voltage heating thermostat which cycles the duct heater burners, with the fan operating continuously.

Plant space design conditions are 78 F dry bulb and 67 F wet bulb in summer, and 75 F DB in winter. Charlotte's summer and winter design conditions are 95 F and 10 F, respectively.

Expected average people load is 250. The building sensible heat gain and loss follow closely the typical industrial flat roof construction ratios, resulting in a winter heat loss 10 percent greater than the summer heat gain. However, taking into consideration the internal winter heat gain (people, machines, and lighting), the total plant winter heat loss has been negligible while the plant is in operation.

The heating equipment installed is basically selected for winter building pulldown after a weekend shutdown. During winter weekend or holiday shutdowns, the heating thermostat is set back to 60 F to hold the building indoor temperature for a reasonable recovery rate upon startup.



ON ROOF, directly above packaged units, are four 40 ton forced draft cooling towers, two of which are shown here. Water cooled condensers are internally circuited for cooling tower operation

Summer total heat gain breakdown by area is: storage, 20 tons; cutting, 25 tons; sewing and ironing, 80 tons; and office, 10 tons. Selection of the total cooling tonnage is based on future expansion of the plant sewing area and includes a planned oversizing of approximately 20 tons.

Equipment maintenance is performed by a plant maintenance foreman, with any major equipment service performed through a service contract with the local heating and air conditioning contractor. The location of the heating and air conditioning equipment lends itself well to easy service access to all components.

Boosts Efficiency, Morale

Since Stately Lady's previous manufacturing plant (in the same city) was not air conditioned, and inside temperatures ran as high as 90 F on some summer days, an immediate increase in employee efficiency and morale was detected shortly after the new plant started operation. Even though the true advantages of a move to a completely air conditioned plant cannot be determined until at least one complete cooling season is experienced, an increase of at least 10 percent in employee efficiency is expected.

For the highly competitive and specialized garment industry, it is essential to incorporate all cost reduction advantages in planning a successful operation. Air conditioning is the most practical and economical way to keep production high through the long months of hot, humid weather.

A comfortable, year 'round indoor working climate helps attract skilled labor . . . and keep it . . . by providing a pleasant working atmosphere in which the employee can keep his earnings high the year 'round due to consistent high-speed quality production. This stabilizing of production rate over the summer and winter months without seasonal slowdowns results in even production output with minimum cost per garment and overhead.

The consulting engineer who designed the system was Rupert Melton. The mechanical (heating, piping, and air conditioning) contractor was Buensod-Stacey, Inc. =

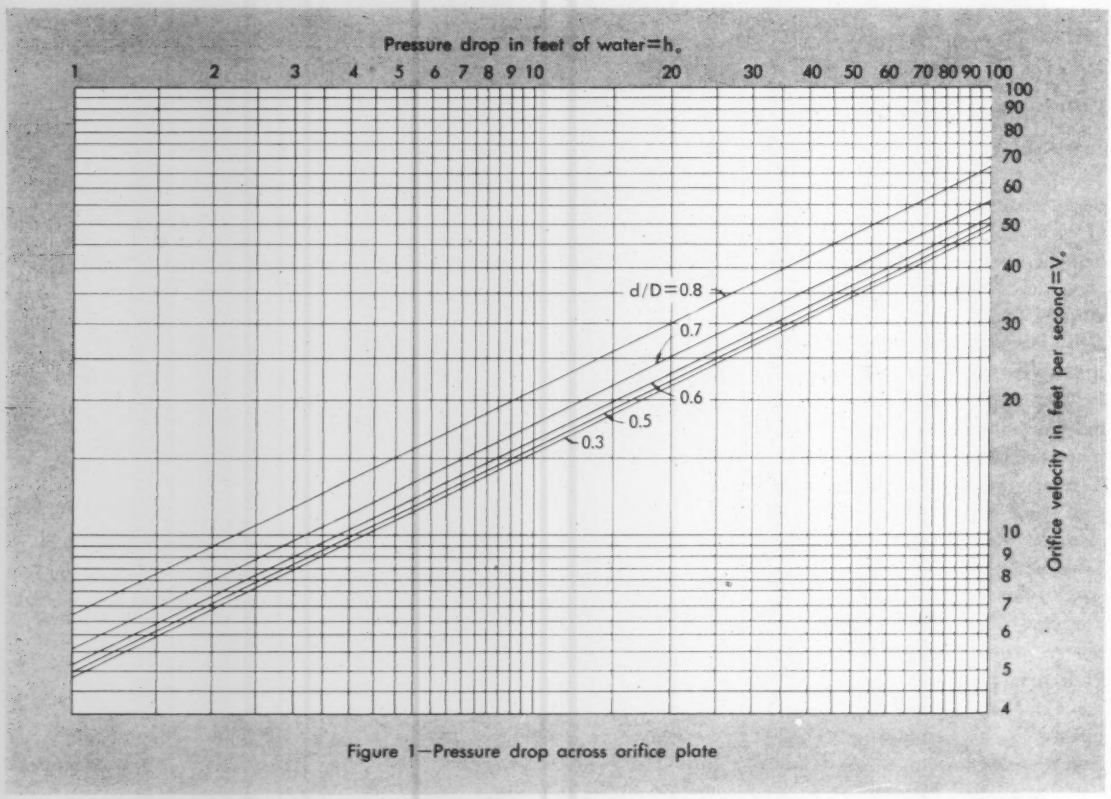


Figure 1—Pressure drop across orifice plate

How to Size and Locate Orifices For Measuring Flow in Piping

● Properly sized orifices installed in piping systems can be a real aid in controlling and measuring the flow rate of the liquid. The graphs presented in this article permit quick determination of orifice sizing and apply to water in the temperature range of 40 to 450 F with reasonable accuracy. Examples showing use of the graphs are included, as is an explanation of orifice location—especially critical to proper performance.

BY JOHN P. JOHNSTON
John P. Johnston & Associates
Consulting Engineers

LIQUIDS and gases comprise the fluids considered in the study of fluid mechanics. An ideal fluid is one in which there is no tangential stress, whether the fluid is in motion or static. Although ideal fluids are non-existent, the motions of real fluids are, to some degree, similar to those of ideal fluids so that accurate mathematical predictions of performance can be made by considering them to be ideal.

Liquids are fluids which are, to all practical consideration, incompressible while gases are, in general, highly compressible by comparison. In other words, a relatively small change in pressure on gases can produce a large change in volume. In many cases where temperature has little effect on pressure and volume, gases in motion may be considered to be incompressible.

Liquids such as water, oil, and alcohol have definite free surfaces. A gas has no free surface. This meaning will be clear by contemplation of a tank containing a gas. Regardless of the quantity of the gas, the entire tank is filled and a definite temperature, pressure, and volume relationship exists. A tank

half full of water is half full—a condition which can only be changed in the concept of a liquid by adding or withdrawing some of the liquid.

It should now be obvious, in the study of the dynamic flow of fluids, that generally liquids must be treated in a different manner than gases because of this temperature-pressure, volume phenomenon which defines compressibility. All data presented will be valid for the flow of liquids and will more specifically be applied to water throughout a range in temperature from 40 to 450 F.

The basic equation for flow of liquids through an orifice is usually presented as:

$$Q = A_2 C \left[1/\sqrt{1 - (d/D)^4}\right] \sqrt{2gh} \quad \ldots\ldots\ldots\ldots [1]$$

where:

Q = liquid flow volume, cfs
A_2 = orifice diameter, sq ft
C = orifice coefficient, dimensionless
d = orifice diameter, ft
D = pipe diameter, ft
g = gravitational constant, 32.2 fps^2
h = pressure difference, ft water gage.

The term $\left[1/\sqrt{1 - (d/D)^4}\right]$ is included in the equation as an approach factor to consider the differences in diameter as related to the vena contracta. This term is sometimes combined with the orifice coefficient, C, to present an overall pipe and orifice coefficient, K. Several authorities present graphical data in which K is plotted in terms of various d/D ratios against Reynolds Number. These curves show the variation in K required to correct for the various methods employed to tap the main piping system or orifice flanges with secondary piping terminating at the flow meter or pressure gage. Examination of the curves will disclose that, for all

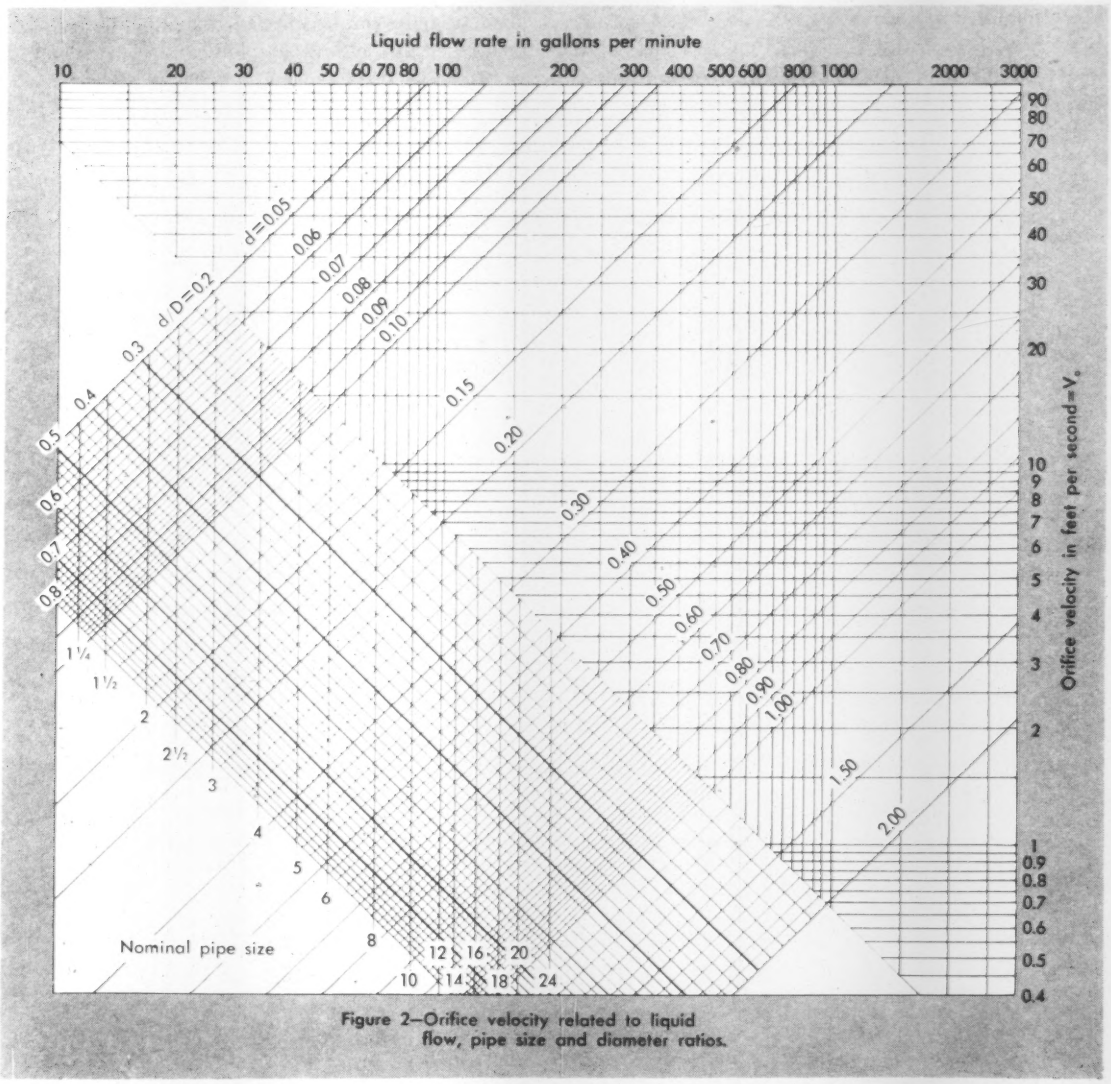


Figure 2—Orifice velocity related to liquid flow, pipe size and diameter ratios.

practical purposes, values of C or K do not vary at values of Reynolds Number in excess of 10^5.

Unless extreme laboratory precision is desired, these variations in the constant may be completely ignored and one set of average values employed with an error of less than $\pm$ ½ percent, as shown in the table below, where representative values of C and K are given. This degree of accuracy should be adequate for the usual commercial or industrial piping system.

d/D	C	K*
0.2	0.604	0.604
0.3	0.605	0.607
0.4	0.606	0.614
0.5	0.607	0.627
0.6	0.608	0.652
0.7	0.611	0.700
0.8	0.643	0.857

*$K = C/\sqrt{1-(d/D)^4}$

Simplify for Graphical Presentation

For use in graphical presentation, Equation 1 has been simplified as follows:

$$Vo = Q/A_2 = C\,[1/\sqrt{1-(d/D)^4}]\,\sqrt{2gh} \quad \ldots\ldots [2]$$

in which the new term, Vo, is equal to the liquid velocity through the orifice in feet per second.

The results obtained from the solution of this equation are shown in Fig. 1. The relationship of pipe diameter, orifice diameters, diameter ratios, volume, and velocity are shown in Fig. 2. Fig. 3 shows values of Reynolds Number plotted in terms of pipe diameter *vs* flow velocity and is computed using a kinematic viscosity corresponding to water at 50 F. The following equations will further explain the function of kinematic viscosity in the calculation of Reynolds Number.

$$N_r = VD\rho/\mu = VD/\mu k \quad \ldots\ldots [3]$$

$$\mu k = \mu/\rho$$

where:

N_r = Reynolds Number, dimensionless
V = liquid velocity, fps
D = pipe diameter, ft
ρ = liquid density, lb per cu ft
μ = viscosity, lb per ft-sec
μk = kinematic viscosity, sq ft per sec.

Should the kinematic viscosity vary, due to a temperature of water other than 50 F, the proper correction factor can be selected from Fig. 4 and, when multiplied by the Reynolds Number selected from Fig. 3, will give the Reynolds Number at the new temperature. The main point in checking this value is

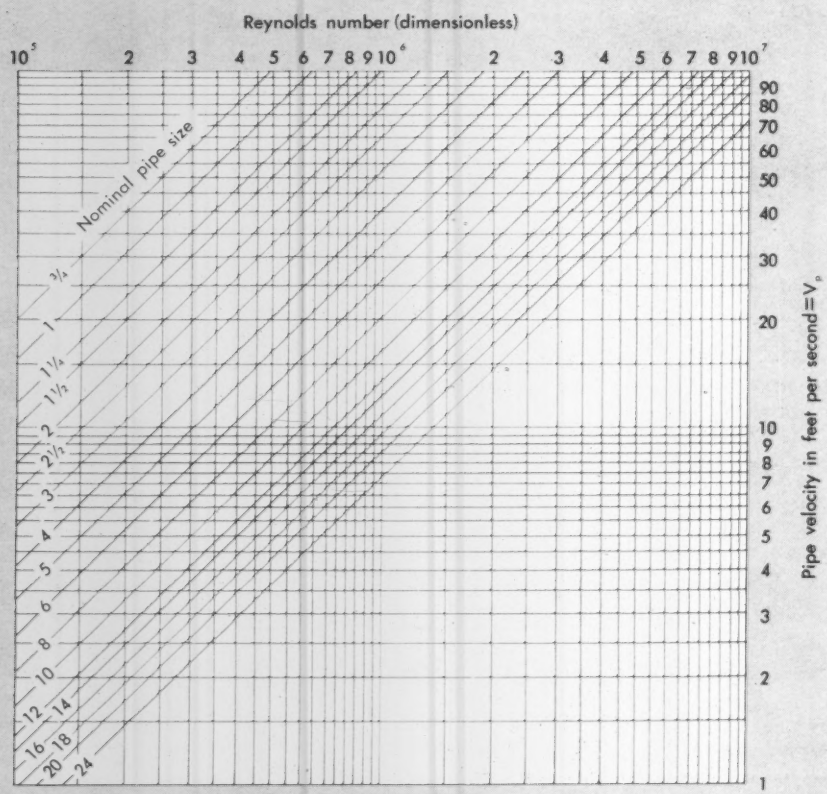


Figure 3—Reynolds number for various flow velocities and nominal pipe sizes.

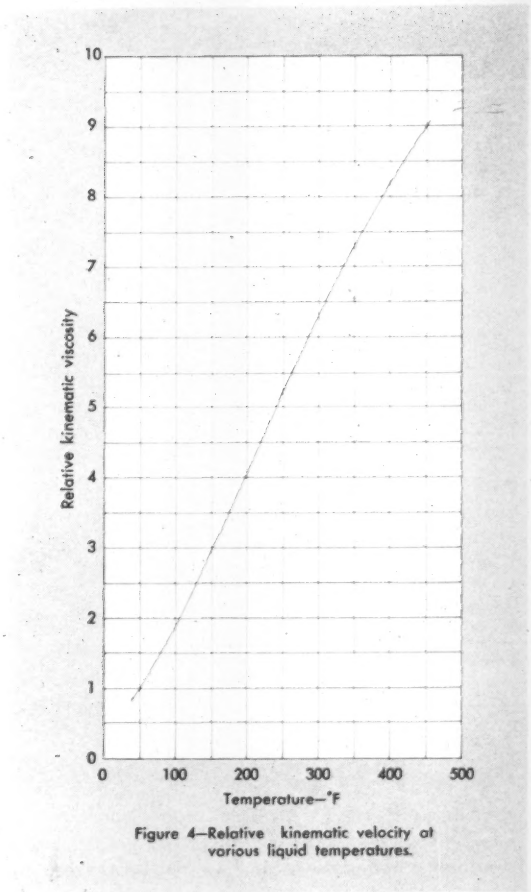


Figure 4—Relative kinematic velocity at various liquid temperatures.

to be sure that it exceeds 10^5 below which the values of C used in constructing the graph would vary to the point where the graph (Fig. 1) should not be used.

Incidentally, Fig. 3 can be used to readily determine the Reynolds Number of any other liquid by dividing its kinematic viscosity in square feet per second into 1.11×10^{-5}. This will give the proper correction factor to be multiplied by the Reynolds Number selected from Fig. 3 and will result in the Reynolds Number for that liquid and flow condition.

Here's How to Use Charts

The following problems will illustrate the use of these charts.

1) Assume a flow of 1500 gpm of 50 F water through a 12 in. pipe at 5.5 fps. From Fig. 3, the Reynolds Number equals 400,000. An orifice is desired which will cause a pressure drop of 15 ft WG for control purposes in which case, from Figs. 1 and 2, the required orifice size is 0.48 ft in diameter.

2) In another location in this same system it is desired to locate an orifice which will cause a pressure drop of 12 in. WG, or a 1 ft head for operation of a flow indicator. Again, from Figs. 1 and 2, the required orifice diameter is selected as 0.80 ft.

3) In a system handling 1200 gpm of 180 F water in a 10 in. pipe at 5.6 fps, Fig. 4 shows that the Reynolds Number correction factor is 3.57 and, from Fig. 3, the Reynolds Number is 350,000. The true Reynolds Number is therefore $350{,}000 \times 3.57 = 1{,}250{,}000$. An orifice is needed to create a pressure drop of 12 in. WG or 1.00 ft for flow indication. By referring to Fig. 1, the velocity through the orifice for that pressure drop is 6.7 fps for d/D equal to 0.8 and 4.8 fps for d/D equal to 0.3. From Fig. 2, these values fall above the 0.8 ratio for a 10 in. pipe. This is an impossible solution, indicating that the pressure drop must be increased and a different flow indicator used. By solving for a 24 in. or 2.0 ft drop, reference to Figs. 1 and 2 shows that an orifice having a diameter 0.63 ft and a d/D ratio of approximately 0.75 will produce this value.

Systems Usually Have Extra Pumping Capacity

In a well-engineered piping system, there will usually be a surplus of pumping capacity, if for no other reason than the fact that the system pressure drop was calculated using friction factors for old pipe and when the system is first put into operation the pipe is new, offering less resistance to flow. In such a case the quantity of water circulated by the pump will increase to the design limit of the impeller. Many times this increased flow of water will create no problems. There are cases, however, where it may be desirable to reduce the flow to the design value.

For example, if the pump is supplying water to a cooling tower, this increase in quantity may cause undue turbulence, splashing, and carryover in the distribution boxes on the tower. Resistance can be added in the system by partially closing a gate valve. This remedy is not satisfactory, since each time gate valves are closed, they must be reset to the proper position. A better solution would be the installation of a balancing cock in the piping system which can be set to the desired position. Unfortunately, in the sizes usually encountered with cooling tower piping systems, these valves are quite expensive.

The best and most economical method, in our opinion, is the installation of pipe flanges at the time the piping system is assembled. This permits the installation of an orifice after the system is in operation and the operating point of the pump is determined from pressure gages and flow meters.

This presents another factor in the design of orifices, since a large portion of the loss across an orifice is regained. Therefore an orifice calculated

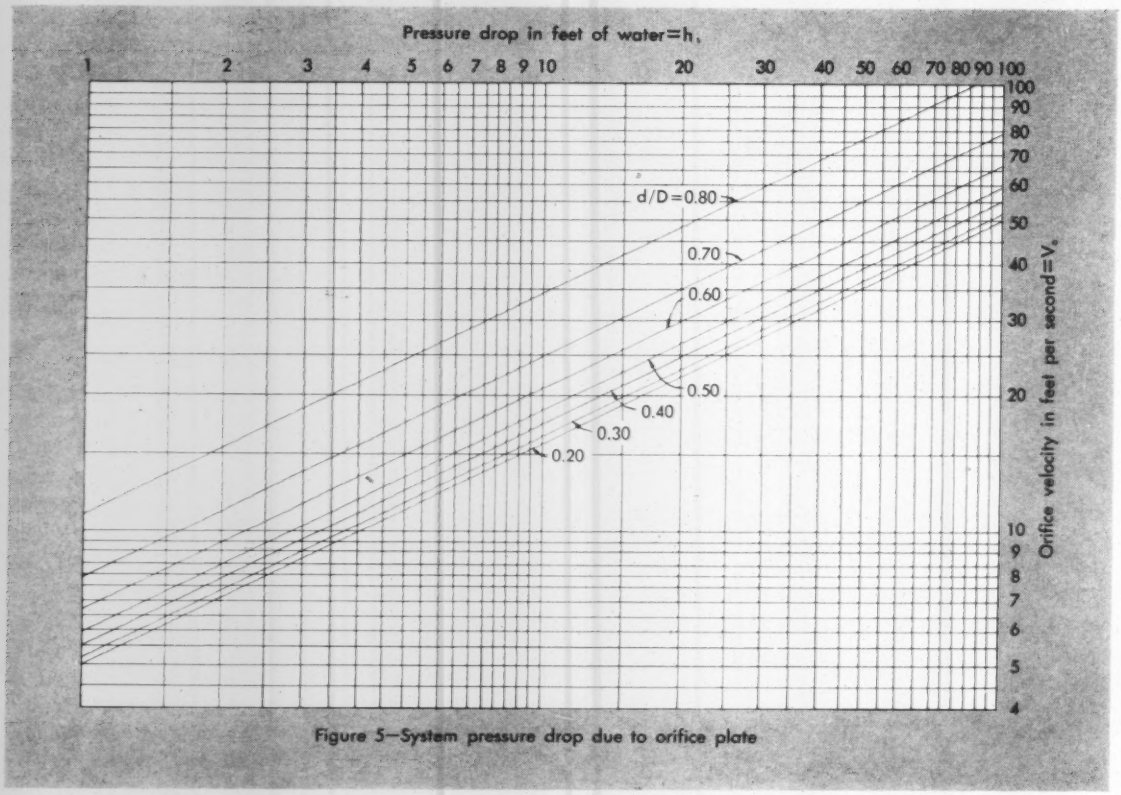


Figure 5—System pressure drop due to orifice plate

from usual equations will not accomplish the desired results. Fig. 5 is similar to Fig. 1 in general appearance except that it incorporates a factor which varies with the d/D ratio. Also, the pressure loss term is not the pressure drop usually measured across the orifice, but is actually the permanent loss to the system resulting from the orifice loss which is considerably greater.

To illustrate the use of this graph, assume a system in which 1850 gpm of water flows to a cooling tower at an average temperature of 90 F in a 10 in. pipe. Design flow is 1620 gpm. Because of water problems at the tower, an orifice is desired to reduce the flow to the design value.

Flanges to receive the orifice, if necessary, were installed at the time of construction. From measurements taken at the installation and by reference to the pump performance data, it is determined that an additional 20 ft in head must be provided to reduce the pump output to the desired 1620 gpm.

From Figs. 3 and 4, Reynolds Number is found to be 685,000 at 1620 gpm. From Figs. 2 and 5, select an orifice having a diameter of 0.41 ft and a d/D ratio of 0.48, and by reference back to Fig. 1 the actual orifice pressure drop is seen to be 27.5 ft of head.

Using this procedure in reverse can be useful in determining the permanent loss resulting from an orifice installed for flow measurement purposes. Using the same system in which 1620 gpm flows at 90 F in a 10 in. pipe, a flow indication orifice of 0.65 ft in diameter is installed to provide a 36 in. or 3.0 ft orifice pressure drop. The d/D ratio is 0.76 and by reference to Fig. 5 it is seen that the permanent system loss is 1.3 ft head at 11.0 fps orifice velocity.

The permanent loss to the system resulting from an orifice installation is less when the d/D ratio is large, i.e., 0.8, and highest when the d/D ratio is small, i.e., 0.2. This function is shown in Fig. 6. Its relationship to an orifice is useful in design since, if permanent loss of some magnitude is not desired, the d/D ratio should be selected as large as possible.

Fig. 7 shows the basic dimensions and relationships desirable in an orifice plate if the values of C are to be maintained. To prevent destruction of the orifice plate by corrosive action, stainless or high chrome steel is suggested as the material from which it should be fabricated.

Locate Orifice Carefully

The final item of importance in the application of an orifice is its location in the piping system. Again,

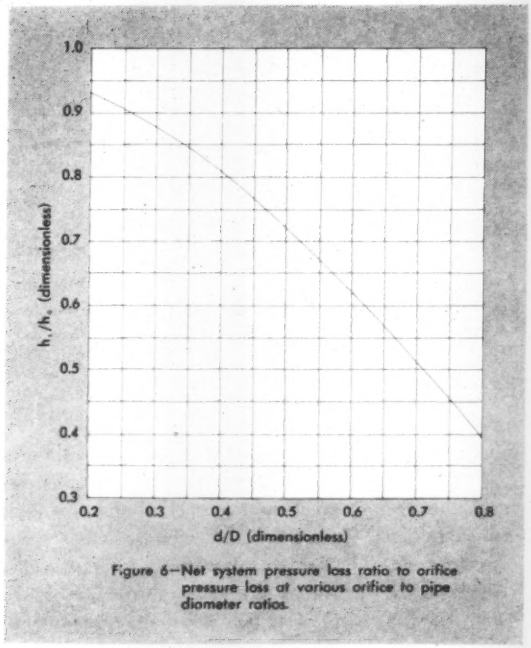


Figure 6—Net system pressure loss ratio to orifice pressure loss at various orifice to pipe diameter ratios.

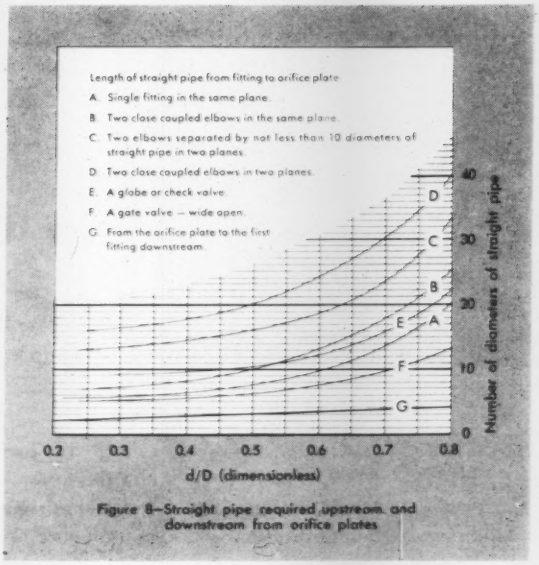


Figure 8—Straight pipe required upstream and downstream from orifice plates

in order for values of C to be maintained and the orifice performance predicted with any degree of accuracy, the liquid must approach the orifice in a steady state, free of disturbances caused by fittings or restrictions upstream. By observation and experimentation, the upstream length of straight pipe necessary to allow the liquid to assume steady state flow after passing a fitting or restriction has been determined and is known.

As a liquid flows through an orifice it assumes a velocity pattern known as the *vena contracta* which is not unlike a venturi tube in appearance. The downstream portion of the vena contracta continues for a certain distance dependent on the d/D ratio and cannot be disturbed or influenced by fittings or restrictions if the values of C are to prevail. These values are also well-established.

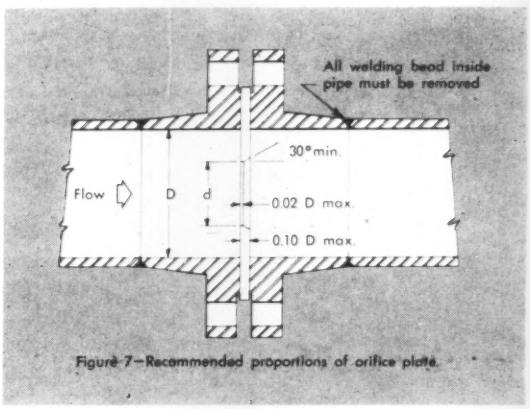


Figure 7—Recommended proportions of orifice plate.

Fig. 8 shows the upstream and downstream requirements of straight pipe for the range of d/D ratios and various types of upstream fitting combinations. In certain instances where it is impossible to maintain the upstream length of straight pipe, the distance may be reduced by the installation of straightening vanes. The length of such vanes should be not less than two pipe diameters and should be located upstream from the orifice, as shown in Fig. 8. Usually these vanes are an item of expense and their use should be given careful consideration.

Answers Not Precise, But Accurate Enough

While the use of this data will not produce precise answers such as might be obtained by the actual solution of the equations, the answers will be quite accurate if care is used in reading the graphs and interpolation of values. For proof of this point, a precise solution is calculated for the third example solved from the charts. Since some value other than the pressure drop must be fixed, the d/D ratio of 0.75 will be used as selected from Fig. 1:

$$Vo = C\,[1/\sqrt{1 - (d/D)^4}]\,\sqrt{2gh}$$

Then:

$C = 0.617$
$h = 2.0$ ft
$D = 10$ in. pipe $= 0.835$ ft diameter
$d = (0.75)\ (0.835) = 0.626$ ft diameter $= 7.512$ in. diameter
$Vo = 0.617\ (1.21)\ (11.35) = 8.471$ fps
$Q = 8.471\ (0.7854)\ (0.626)^2\ (60)\ (1728)/231 = 1170.19$ gpm

This Q value of 1170.19 gpm, compared with the 1200 gpm given in the third example solved from the charts, proves the charts to be accurate within 2.5 percent. ≠

NEW 14-STORY structure in southern India features year 'round comfort cooling, dehumidification—first installation of its type there

Sun Control Essential To Cooling in India

BY JOHN I. YELLOTT
Consulting Engineer

CENTRAL AIR CONDITIONING for cooling and dehumidification and attention to sun control are two outstanding features of the first skyscraper to be erected in southern India. Just completed in Madras, only 13 deg north of the equator on the Bay of Bengal, the 14-story structure houses the southern regional offices of the nationalized Life Insurance Corp. of India.

Under construction since 1953, this is the first completely air conditioned office building in this part of the world.

Heating is never needed in Madras, but cooling and dehumidification are required the year 'round. Sun control is essential not only on the south and west sides of the building, but on the north and east as well, because, at such a low latitude, the sun spends much of its time high in the northern sky.

Cooling requirements called for installation of 400 tons of refrigeration to maintain a uniform indoor temperature of 75 F at 58 percent relative humidity.

A centrifugal compressor is driven through a step-up gear set coupled to a 450 hp wound rotor motor. Pumps circulate cooling water from the equipment room in the basement to a cooling tower on the penthouse on the 14th-floor terrace. Fans return cooled and dehumidified air through steel ducts to the floors below.

Sun control is a matter of urgency in India. The orientation of this building is such that it was taken into account on each face to cut down on the solar radiation load.

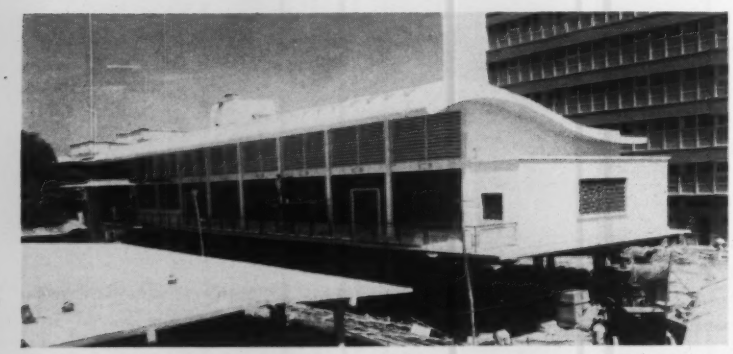
The narrow south-east face, which receives the heaviest load, is limited to stairways and elevators, and has only small windows.

The canteen block provides an excellent example of the sun control devices which have been adapted. Louvers, screen walls, and a gracefully curved roof are used to ward off the solar load. Light and air enter freely through the louvers and screen wall openings, but the direct rays of the sun are effectively excluded.

Sun control on the long south-east and north-west walls is accomplished by recessing the windows some 18 in. behind the plane of these surfaces. The lower half of the glass window panels on these walls is insulated with blue-painted hard board and aluminum foil. The upper half is shaded from the sun's direct rays virtually all day by panels of specially treated ¼ in. sheet glass supported on a horizontal band in the plane of the walls.

Some of these windows can be opened for ventilation during the brief periods of the year when air conditioning is not essential, but most are fixed in a closed position. Window washing is accomplished by means of a maintenance trolley which can move both vertically and horizontally around the building.

Some 26,000 sq ft of plate glass is used in the windows themselves. Aluminum venetian blinds are provided throughout the building to give additional protection from the sun in the early morning and late afternoon. ≠



CANTEEN BLOCK (restaurant and store) has louvered, curved roof and shading devices in walls to ward off sun's direct rays

How to Determine Fan Air Flow Rates

BY DAVID P. COSTA
Naval Material Laboratory
Heating, Ventilating, and Air Conditioning Section

COMMONLY encountered in ventilation work and in the testing of fans for performance and rating is the determination for air flow rates given by the equation[1]:

$$Q = 1096.2 \times A \times \sqrt{Pv/\rho} \quad \text{.....[1]}$$

[1]NAFM-ASHAE Standard Code for the Testing of Centrifugal and Axial Fans. ASME Test Code for Fans.

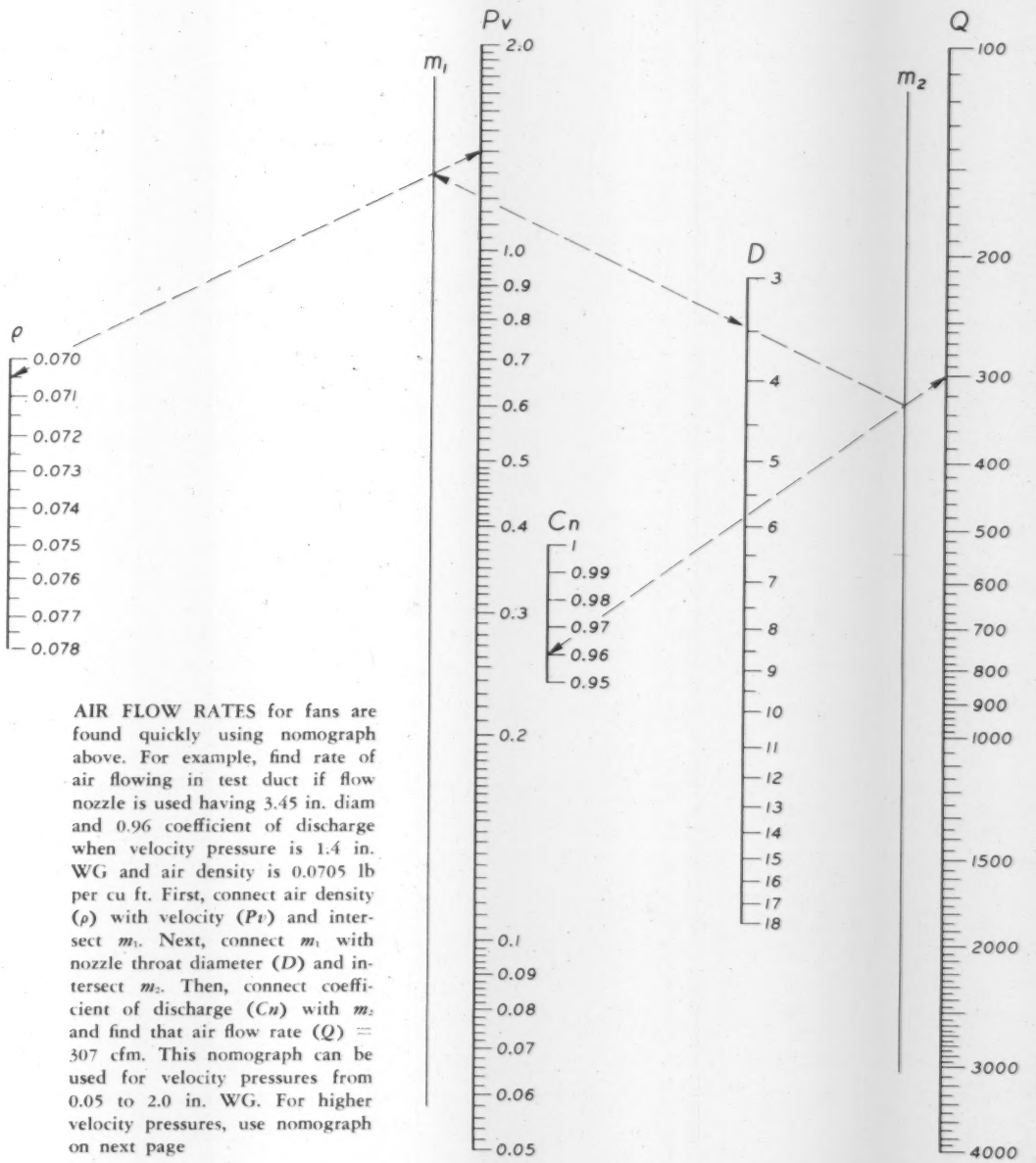
or

$$Q = 5.988 \times D^2 \times \sqrt{Pv/\rho} \quad \text{.....[2]}$$

where:

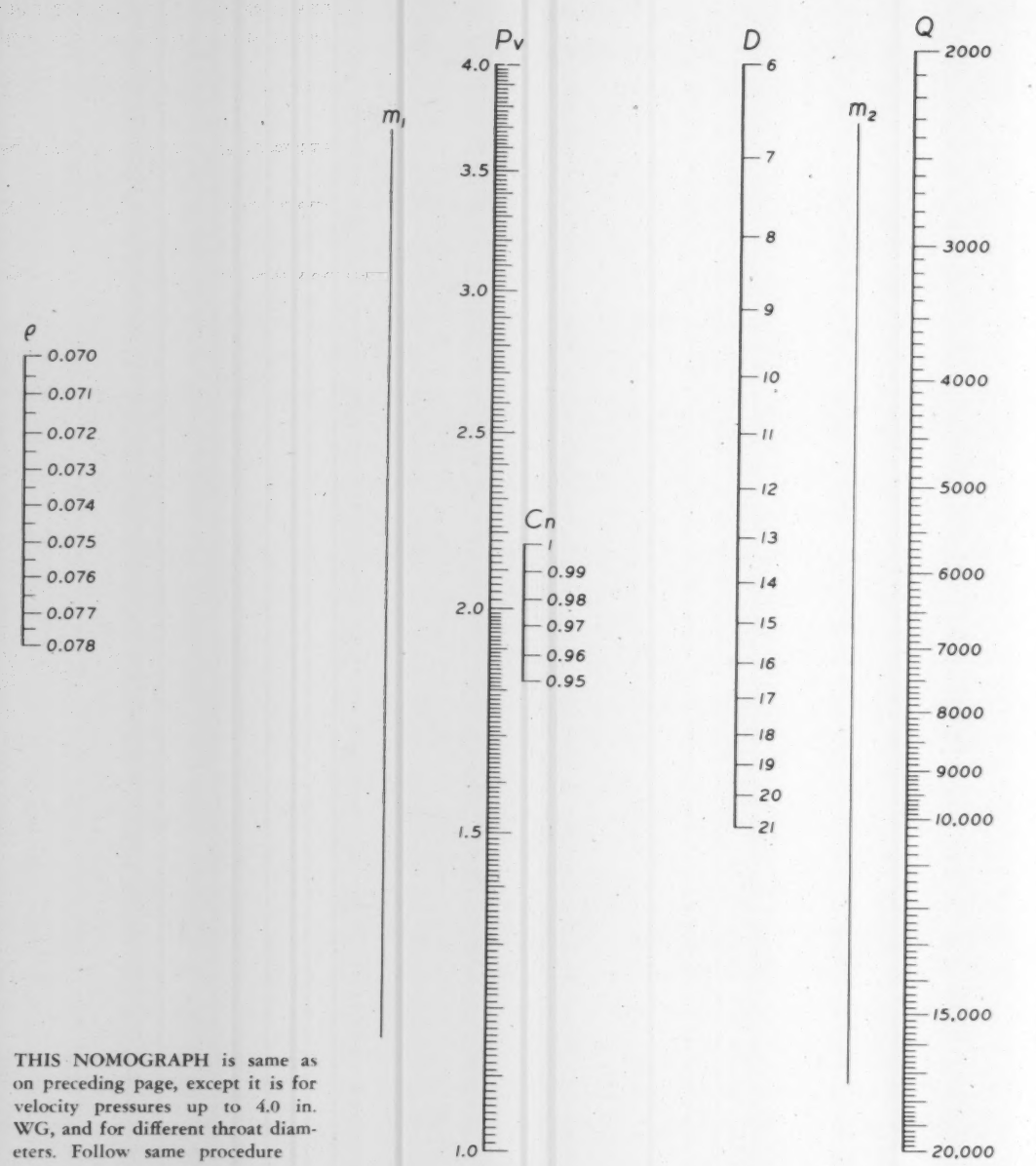
Q = air flow rate, cfm
A = area of test duct at pitot tube station, sq ft
Pv = velocity pressure corresponding to average velocity, in. water gage
ρ = density of air at point of measurement, lb per cu ft
D = diameter of test duct at pitot tube station, in.

In order to vary the amount of air flowing through the test duct, some form of throttling device is used. This is usually a cone damper and is



AIR FLOW RATES for fans are found quickly using nomograph above. For example, find rate of air flowing in test duct if flow nozzle is used having 3.45 in. diam and 0.96 coefficient of discharge when velocity pressure is 1.4 in. WG and air density is 0.0705 lb per cu ft. First, connect air density (ρ) with velocity (Pv) and intersect m_1. Next, connect m_1 with nozzle throat diameter (D) and intersect m_2. Then, connect coefficient of discharge (Cn) with m_2 and find that air flow rate (Q) = 307 cfm. This nomograph can be used for velocity pressures from 0.05 to 2.0 in. WG. For higher velocity pressures, use nomograph on next page

HPAC DATA SHEET



THIS NOMOGRAPH is same as on preceding page, except it is for velocity pressures up to 4.0 in. WG, and for different throat diameters. Follow same procedure

placed upon the end of the discharge duct for blowing fans or at the entrance to the inlet duct for exhausting fans. The pitot tube traverse method is the one generally adopted for all performance and witness tests.

Frequently in research and development work, the flow nozzle[2] is used instead of the pitot tube and damper arrangement. It serves both as a throttling medium and as a metering device. While the pitot tube requires a simpler setup than the flow nozzle, it requires much more time for its use. Seven or eight flow nozzles of varying size are required to obtain a complete curve from no air delivery to free delivery. An accurately calibrated flow nozzle makes a convenient measuring device for research.

[2]ASME Power Test Code on Flow Measurement, 1949.

Equation 1 is modified below to include a nozzle coefficient of discharge for use when a flow nozzle is used as the basis for determining air flow:

$$Q = 1096.2 \times A \times Cn \times \sqrt{Pv/\rho} \quad \text{.....[3]}$$

or

$$Q = 5.988 \times D^2 \times Cn \times \sqrt{Pv/\rho} \quad \text{.....[4]}$$

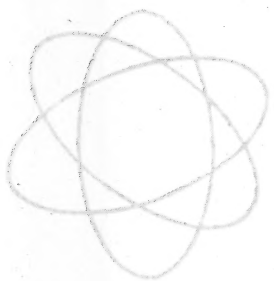
where:

A = nozzle throat area, sq ft
Cn = nozzle coefficient of discharge
D = nozzle throat diameter, in.

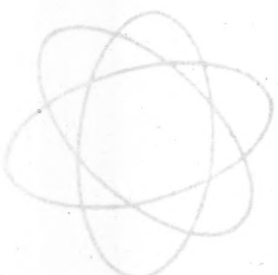
The nomographs provide a means for determining the rate of air flow by either the pitot tube or the flow nozzle arrangement. If the former is employed, the value of Cn is taken as unity and Equation 2 applies. If the latter, then Equation 4 applies. ∓

The opinions expressed herein are those of the author and are not necessarily those held by the Naval Material Laboratory nor any branch of the Navy Dept.

Piping Code Committee Interprets Nuclear Cases



• Since the Code for Pressure Piping, ASA B31, was last issued, the Sectional Committee on the Code has been asked to interpret various statements contained therein. While these cases represent the opinion of the committee, they will not become parts of the Code until formal actions have been taken. The following cases, namely N-1, N-7, N-8, N-9, and N-10, have been approved for publication. Case No. N-1 is an "enabling" case. Cases Nos. N-7 through N-10 are specific cases. Cases Nos. N-2 and N-6 are not ready for publication at this time; however, they are currently under review by the Advisory Committee on Nuclear Piping and will be submitted to the Executive Committee for review and approval at the earliest possible date.



Case No. N-1

Inquiry: Under what section of the ASA Code for Pressure Piping should piping in nuclear power plants be designed and constructed? What special requirements must be met?

Reply: It is the opinion of the committee:

1) That piping associated with nuclear power plants falls into two categories:

a) Conventional steam and associated service piping, not falling under the definition of nuclear piping [see item (b)]. This piping shall be designed and constructed in accordance with B31.1.

b) Nuclear piping which is defined as that piping designed to contain a fluid whose loss from the system could result in a radiation hazard either to the plant personnel or to the general public. Power piping coming within the scope of this definition shall be designed and constructed in accordance with B31.1, supplemented by the rulings and case interpretations identified by the prefix "N."

2) That specific exclusions and special requirements will be covered in nuclear cases as they are developed. These will be issued and numbered with the prefix "N."

Case No. N-7

Inquiry: May Types 304, 304L, 316, 316L, 321, 347, 348, 309, and 310 grades of stainless steel be used for piping of aqueous type reactors in nuclear energy installations under the rules of Section 1 of the Code for Pressure Piping?

Reply: It is the opinion of the committee that Types 304, 304L, 316, 316L, 321, 347, 348, 309, and 310 stainless steels may be used for piping of aqueous type reactors in nuclear energy installations for construction under Section 1, provided the following conditions are observed:

1) The materials shall at least conform to one of the following specifications:

Pipe	A376
	A358
Welding fittings	ASTM A403
Forgings	ASTM A182

The minimum carbon content of Types 304, 316, 321, 347, 348, 309 and 310 shall be 0.04 to 0.10 percent by check analysis, and the maximum carbon content

of Types 304L and 316L shall be 0.035 percent by check analysis.

2) If welding is employed, all completed welds shall be inspected as follows:

a) All longitudinal welds shall be fully radiographed.

b) All circumferential welds shall be fully radiographed.

c) Where the size or configuration of the weld does not permit effective radiographing, it shall be examined by the fluid penetrant method.

d) Provisions (a) through (c) do not apply for services at or near the ordinary range of atmospheric temperatures where these materials are employed primarily for their corrosion resistance, provided the piping is hydrostatically tested at 1½ times the maximum allowable working pressure for the piping used.

3) The design temperature shall not exceed 800 F.

4) The allowable stress values for seamless materials shall be as indicated in Table 1 below.

5) A joint factor of 1.00 shall be applied to welded construction that has been fully radiographed.

Case No. N-8

Inquiry: May Types 304, 316, 321, 347, 348, 309, and 310 stainless steel be used for piping of nuclear energy installations handling liquid sodium and sodium-potassium mixtures under the rules of Section 1 of the Code for Pressure Piping?

Reply: It is the opinion of the committee that Types 304, 316, 321, 347, 348, 309, and 310 stainless steels may be used for the piping of nuclear energy installations handling liquid sodium and sodium-potassium mixtures for construction under Section 1, provided the following conditions are observed:

1) The materials shall at least conform to one of the following specifications:

Pipe	ASTM A376
	ASTM A358
Welding fittings	ASTM A403
Forgings	ASTM A182

The carbon content shall be 0.04 to 0.10 percent by check analysis.

2) If welding is employed, all completed welds shall be inspected as follows:

a) All longitudinal welds shall be fully radiographed.

b) All circumferential welds shall be fully radiographed.

c) Where the size or configuration of the weld does not permit effective radiographing, it shall be examined by the fluid penetrant method.

3) The allowable stress values for seamless materials shall be as follows:

Temperature, F	304	316	321 347 348	309	310
−20 to 100	18,750	18,750	18,750	18,750	18,750
200	16,650	18,750	18,750	18,750	18,750
300	15,000	17,900	17,000	17,300	18,500
400	13,650	17,500	15,800	16,700	18,200
500	12,500	17,200	15,200	16,600	17,700
600	11,600	17,100	14,900	16,500	17,200
650	11,200	17,050	14,850	16,450	16,900
700	10,800	17,000	14,800	16,400	16,600
750	10,800	16,900	14,700	16,200	16,250
800	10,000	16,750	14,550	15,700	15,700
850	9,700	16,500	14,300	14,900	14,900
900	9,400	16,000	14,100	13,800	13,800
950	9,100	15,100	13,850	12,500	12,500
1000	8,800	14,000	13,500	10,500	11,000
1050	8,500	12,200	13,100	8,500	7,100

Note: These stress values do NOT include joint factors or quality factors.

4) It shall be the responsibility of the designer to take into account the decarburization of stainless steels in sodium and NaK.

5) A joint factor of 1.00 shall be applied to longitudinal welds which have been fully radiographed.

Case No. N-9

Inquiry: Under what conditions may centrifugally cast austenitic stainless steel pipe be used within the scope of Section 1 of the Code for Pressure Piping for nuclear service?

Reply: It is the opinion of the committee that the intent of the Code will be satisfied, provided the following conditions are met:

TABLE 1 — MAXIMUM ALLOWABLE STRESS VALUES for seamless materials covered in Case No. N-7 shall be as follows:

	Temperature, F									
	−20 to 100	200	300	400	500	600	650	700	750	800
304	18,750	16,650	15,000	13,650	12,500	11,600	11,200	10,800	10,400	10,000
304L	17,500	15,300	13,100	11,000	9,700	9,000	8,750	8,500	8,300	8,100
316	18,750	18,750	17,900	17,500	17,200	17,100	17,050	17,000	16,900	16,750
316L	17,500	16,250	14,500	12,000	11,000	10,150	9,800	9,450	9,100	8,800
321	18,750	18,750	17,000	15,800	15,200	14,900	14,850	14,800	14,700	14,550
347	18,750	18,750	17,000	15,800	15,200	14,900	14,850	14,800	14,700	14,550
348	18,750	18,750	17,000	15,800	15,200	14,900	14,850	14,800	14,700	14,550
309	18,750	18,750	17,300	16,700	16,600	16,500	16,450	16,400	16,200	15,700
310	18,750	18,750	18,500	18,200	17,700	17,200	16,900	16,600	16,250	15,700

Note: These stress values do NOT include joint factors or quality factors.

stainless steel pipe be used for nuclear service?"

1) Chemistry and mechanical property requirements:

a) The chemistry and tensile requirements shall be as given in ASTM A351. These shall be established from a sample ring cut from one end of each length of pipe, using the testing procedure given in ASTM Specification A370.

b) The bending properties shall be established as required by ASTM A376, Paragraphs 10 and 11.

2) Finish:

a) The inside and outside surfaces shall be finish machined.

b) The material shall have a finish of 250 micro-in. RMS or 225 micro-in. AA or better.

3) Testing:

a) *Pressure test*: Each length of pipe shall be given a pressure test and shall show no leaks with the test pressure held for a period of 30 min per in. of wall thickness. The test pressure shall be at least 1½ times the rated pressure of the pipe at room temperature, except that the stress developed at the test pressure shall not exceed 90 percent of the specified minimum yield strength based on the actual wall thickness.

b) *Surface inspection by fluid penetrant*: In addition to visual inspection, all surfaces of each length shall be inspected by the fluid penetrant method. The following standards of acceptance shall be met:

All linear discontinuities and aligned penetrant indications revealed by the test shall be removed. Aligned penetrant indications are those in which the average of the center-to-center distances between any one indication and the two adjacent indications in any straight line is less than 3/16 in.

All other discontinuities revealed on the surface need not be removed unless the discontinuities are also revealed by radiography, in which case the pertinent radiographic specification shall apply.

c) *Radiography*: Each length of pipe shall be completely radiographed in accordance with ASTM E94 and shall meet the requirements of ASTM E71 for Class 2 quality castings.

4) Defects disclosed by inspection and testing may be repaired by welding under the following conditions:

a) The defect shall be removed and the surface of the cavity rendered clean.

b) Repair welding shall be done using procedures and operators that have been qualified in accordance with the requirements of ASTM A376.

c) All repair welds shall be examined by the same procedures and to the same standards as the original cast material.

d) If the material had been heat treated before making the repair weld, the length shall be reheat treated.

5) Heat treatment shall consist of 1950 F minimum metal temperature and shall be cooled in air or liquid medium at a rapid rate.

6) Pipe sections that have been subjected to hot forming operations such as bending, swaging, forging, van-stoning, and similar forming operations shall be reheat treated in accordance with Paragraph (5), and fluid penetrant tested.

7) Records:

a) Certified test reports shall give the results of the chemical and tensile properties, and shall specifically indicate that each of the other test requirements in this case have been met. In the event that the inspector did not witness the removal and repair welding of any defects, the test report shall contain a statement as to the number, approximate extent and location of such repairs.

b) All radiographs of original material and repaired areas shall be kept for a period of three years and shall be available to the inspector at all times.

8) If the results of any chemical or mechanical tests do not conform to the requirements, retests shall be made on additional ring samples of double the original number, each of which shall conform to the requirements as specified.

9) It shall be the responsibility of the designer to require any or all of the following where service conditions or welding requirements warrant and when so specified becomes a requirement of this case.

a) Where gaseous products of nuclear fission are anticipated, mass spectrometer or other gaseous leakage tests shall be specified.

b) Where cold forming or hot forming are to be considered, ductility shall be compatible with the type of forming.

10) The maximum allowable stress, in psi, for use under this case shall be as given in the following table:

Temperature, F	Maximum allowable stress values in tension, psi, for ASTM A351 grade				
	CF8	CF8M	CF8C	CH20	CK20
−20 to 100	17,500	17,500	17,500	17,500	16,250
200	15,700	16,900	17,000	16,100	15,300
300	14,250	16,500	15,600	15,150	14,900
400	13,100	16,300	14,200	14,600	14,600
500	12,200	15,900	13,000	14,550	14,550
600	11,700	15,350	12,200	14,450	14,450
650	11,500	15,000	11,900	14,400	14,400
700	11,300	14,700	11,700	14,350	14,350
750	11,100	14,350	11,600	14,300	14,300
800	10,900	14,000	11,500	14,150	14,150
850	10,650	13,530	11,350	13,900	13,900
900	10,400	13,000	11,200	13,500	13,500
950	10,100	12,350	11,100	12,500	12,500
1000	9,850	11,700	11,000	10,500	11,000
1050	9,600	10,600	10,900	8,500	9,750

Note: These stress values are based on a casting quality factor of 1.00. Specific minimum tensile strengths for the above are 65,000 psi for CK20, and 70,000 psi for the remainder.

"Where may austenitic steel butt welding fittings be used?"

Case No. N-10

Inquiry: Under what conditions may cast austenitic steel butt welding fittings be used within the scope of Section 1 of the Code for Pressure Piping for nuclear service?

Reply: It is the opinion of the committee that ASTM Specification A351 and ASA B16.9 are not sufficiently definitive for acceptance for nuclear service as currently written. It is the opinion of the committee that the intent of the Code will be satisfied provided the following conditions are met:

1) Chemistry and mechanical property requirements:

a) The chemistry and tensile requirements shall be as given in ASTM A351 and shall be established using testing procedures as given in ASTM A370. The test bars attached to the keel blocks shall be of such dimensions that they shall reflect the greatest casting thickness and there shall be a minimum of three test bars per heat per heat treatment lot and they shall be marked with the heat numbers and other pertinent identification. The test bars shall accompany the castings through all heat treatment.

2) Finish:

a) The castings shall meet the requirements of A351, Paragraph 18. Attention is directed to the prohibition against plugging in Paragraph 18 (b).

b) Fittings shall have an interior surface finish of 250 micro-in. RMS or 225 micro-in. AA or finer.

3) Testing:

a) *Pressure test*: Each fitting shall be given a pressure test and shall show no leaks with the test pressure held for a period of 30 min per in. of wall thickness. The test pressure shall be at least 1½ times the rated pressure of the fitting at room temperature, except that the stress developed at the test pressure shall not exceed 90 percent of the specified minimum yield strength based on the minimum specified wall thickness.

b) *Surface inspection by fluid penetrant*: In addition to visual inspection, all surfaces of each fitting shall be inspected by the fluid penetrant method. The following standards of acceptance shall be met:

All linear discontinuities and aligned penetrant indications revealed by the test shall be removed. Aligned penetrant indications are those in which the average of the center-to-center distances between any one indication and the two adjacent indications in any straight line is less than 3/16 in.

All other discontinuities revealed on the surface need not be removed unless the discontinuities are also revealed by radiography, in which case the pertinent radiographic specification shall apply.

c) *Radiography*: Each fitting shall be completely radiographed in accordance with ASTM E94 and shall meet the requirements of ASTM E71 for Class 2 quality castings.

4) Defects disclosed by inspection and testing may be repaired by welding under these conditions:

a) The defect shall be removed and the surface of the cavity rendered clean.

b) All basic requirements and optional requirements for repairs of defects and retest shall be in accordance with the applicable paragraphs of ASTM A351, and shall be mandatory except that reheat treatment following repairs shall be commensurate with the service.

c) All repair welds shall be examined by the procedures and to the same standards at the original cast material.

5) *Heat treatment*: Each treatment shall consist of 1950 F minimum metal temperature and shall be cooled in air or liquid medium at a rapid rate.

6) Records:

a) Certified test reports shall give the results of the chemical and tensile properties, and shall specifically indicate that each of the other test requirements in this case have been met. In the event that the inspector did not witness the removal and repair welding of any defects, the test report shall contain a statement as to the number, approximate extent, and location of such repairs.

b) All radiographs of original material and repaired areas shall be kept for a period of three years and shall be available to the inspector at all times.

7) If the results of any chemical or mechanical tests do not conform to the requirements, retests must be made in accordance with Paragraph 11 of ASTM A351.

8) It shall be the responsibility of the designer to require any or all of the following where service conditions or welding requirements warrant and when so specified become a requirement of this case.

a) Where gaseous products of nuclear fission are anticipated, mass spectrometer or other gaseous leakage tests shall be specified.

b) Commensurate with the service,

... the chemistry and tensile requirements shall be as given in ASTM A351. The tensile requirements shall be determined from a sample ring cut from one end of each fitting, using the testing procedures as given in ASTM A370;

... the flattening properties shall be established as required by ASTM A376, Paragraph 11.

9) Fittings produced in compliance with this case shall be based on the allowable stress data given for pipe. See Case No. N-9. ≠

How to Apply Direct Fired Heaters For Winter Makeup Air Supply

• All air exhausted from a building must be replaced by an equal amount of makeup air. During winter this makeup air must be heated to avoid discomfort to occupants. The use of direct fired heaters is one way to do this. Individual requirements, of course, vary. By knowing the amount of air exhausted, the outside design temperature, and the heater discharge temperature required, heaters can be sized very easily. The author herein tells the procedure to follow.

Mr. Stern is a 1943 mechanical engineering graduate of the Northwestern Technological Institute. Following graduation he served as an engineering officer in the U.S. Navy. After World War II he worked for Underwriters' Laboratories, Inc., and from there went into apprentice training as a field service engineer on industrial heating equipment. He was later employed in engineering research and sales. Before joining Lennox in 1957, Mr. Stern was president of a business which designed, manufactured, and sold large capacity direct fired space heaters.

BY M. H. STERN
Industrial Market Manager
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WHEN it is not practical to reclaim contaminated air exhausted from a building and return it to the heated space, it is essential that makeup air be provided in the same quantity as that exhausted. It is a false economy to overlook this requirement, because without it, unheated outside air will leak into the building through doors, windows, and other openings causing drafts and discomfort. Also, the efficiency of the exhaust system will be reduced, since the contaminated air cannot be removed as fast as desired under design conditions.

To provide the necessary amount of makeup air during the winter months without causing discomfort, it must be heated. To determine the size of heater required, only the three following factors need to be known:

1) Air quantity exhausted from the space or building

2) Outdoor design temperature

3) Discharge air temperature required (normally 80 F).

To illustrate the procedure to follow, an example dealing with a paint spray booth will be given. The booth is to be pressurized to prevent unfiltered air from coming in contact with the painted surfaces. A booth of this type is usually serviced by a conveyor system and is classified as a closed system. Such a booth is shown in Fig. 3. Note that the makeup air is introduced from the outside and passed through the direct fired heater where it is heated to approximately 80 F. From the warm air plenum above the booth the air is filtered and then enters the work area.

The filter bank serves two functions; it filters the air and also reduces the velocity so the air flow will be uniform throughout the booth.

Operating conditions are as follows:

1) The air quantity exhausted is 10,000 cfm.

2) The outdoor design temperature is zero F.

3) The discharge air temperature required is 80 F.

Since it is desired to pressurize the work area, more air than is being exhausted must be introduced. The general procedure is to supply 10 percent more air than is being exhausted. The heater size would then be based on an air flow rate capacity of 11,000 cfm.

Find Heater Output Capacity

To determine the heat output capacity, the following equation may be used:

$$Q = \text{cfm} \times 1.08 \times \text{temperature differential}$$
$$Q = 11{,}000 \times 1.08 \times 80 = 950{,}000 \text{ Btu per hr}$$

where:

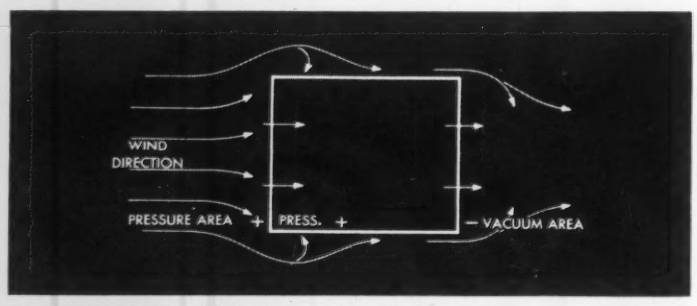
Q = heat output capacity, Btu per hr
1.08 = conversion factor consisting of 60 × air density × specific heat of air.

WHY IS MAKEUP AIR SUPPLY NEEDED?

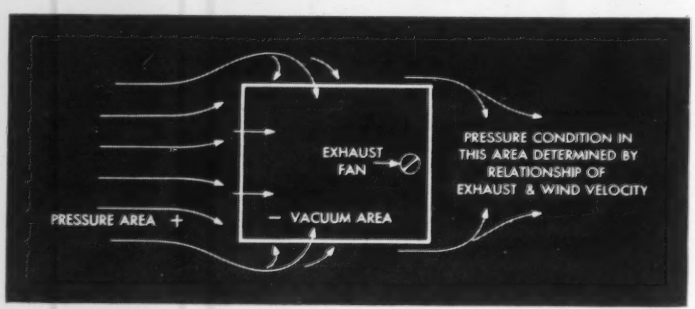
Laboratory and field tests have shown that wind pressure will produce a slight positive pressure within a building causing the air movement to be from the windward to the leeward side. The air ingress to the building in this case is a result of natural conditions, as shown in Fig. 1.

The same building is shown in Fig. 2 with a mechanical exhaust system which will produce a negative pressure within the heated space. Air from outside will now infiltrate through all openings. Thus, the condition is aggravated. Just how much it is affected depends on the capacity of the exhaust system.

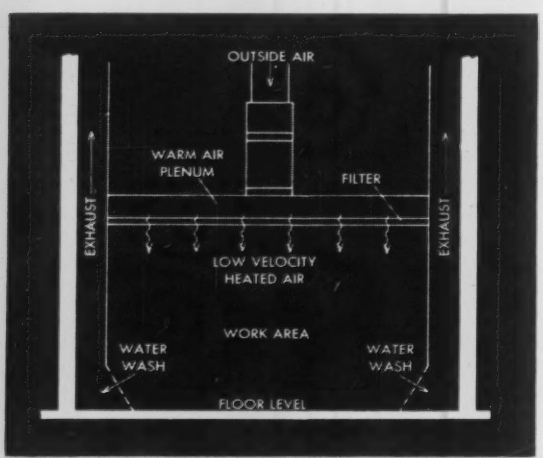
However, when a makeup air supply system is provided, the pressure condition within the building will be the same as though an exhaust system had not been installed. Of course, this is only true if the makeup air quantity is equal to the quantity of air that is being exhausted. In some cases it may be desirable to design the makeup air system to deliver an air quantity in excess of the quantity being exhausted so as to produce a positive pressure within the space.



1 AIR PRESSURE INCREASE within a building can be caused by natural conditions



2 MECHANICAL EXHAUST SYSTEM will produce negative pressure, causing outside air to infiltrate through all openings



3 THIS PAINT SPRAY BOOTH is pressurized to keep unfiltered air from coming in contact with painted products. Makeup air enters from outside, passes through direct fired heater where it is heated to about 80 F

Therefore, the heater capacity must be at least 950,000 Btu per hr output.

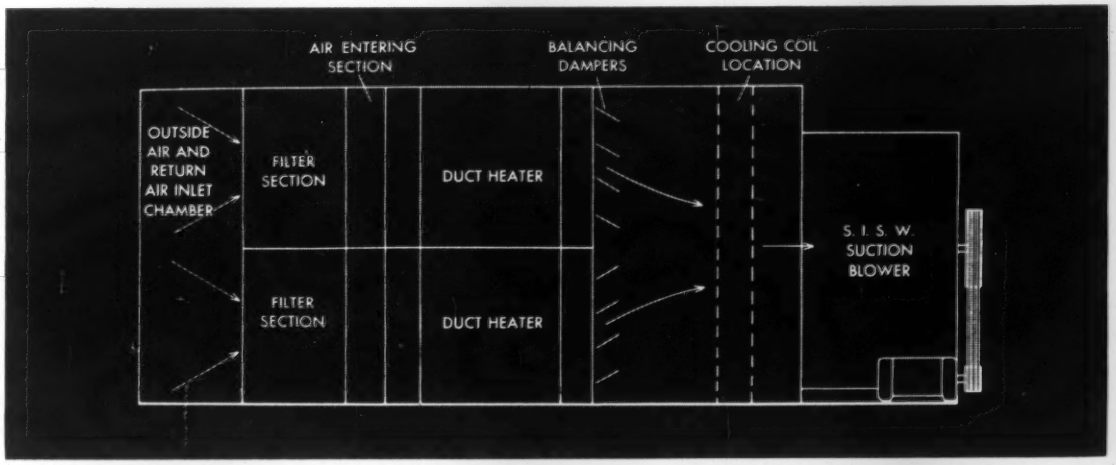
The usual practice for heater manufacturers is to publish the cfm capacity and brake-horsepower as a function of the external static pressure to the heater based upon standard air at 70 F. This data must be corrected if the fans are to handle air at a temperature other than 70 F.

Since the air at design conditions in this example will enter the fans at zero F, a correction must be made, and this can be done as follows:

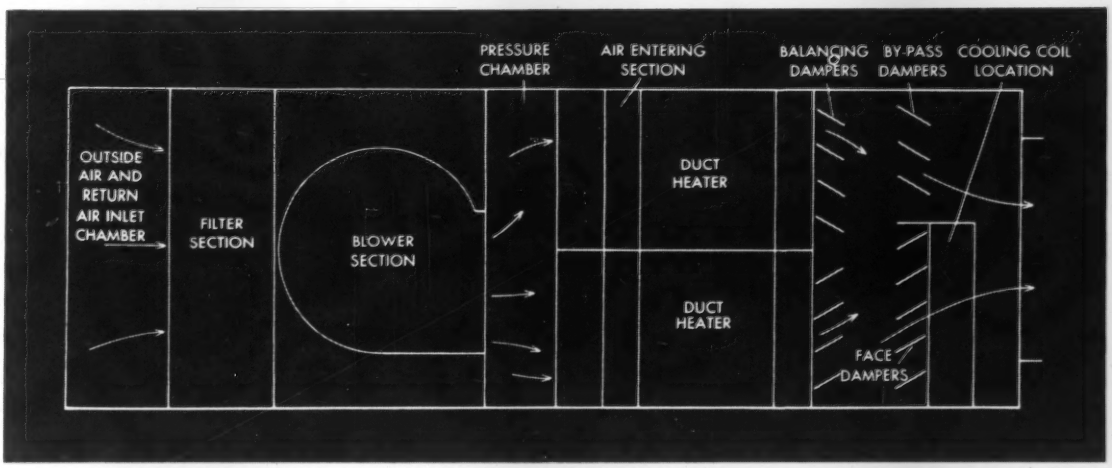
1) Standard air quantity is 11,000 cfm at an external static pressure of 0.5 in. water gage; inlet air temperature, zero F; temperature rise, 80 F.

2) Since the air quantity varies directly as the absolute temperature, the corrected cfm can be obtained by multiplying 11,000 by 460 and dividing by 530. The answer is 9600 cfm.

From the fan data it is noted that, for 9600 cfm



4 IN CENTRAL STATION INSTALLATIONS, outside or recirculated air can be handled with pull-through, single-inlet, single-width blower



5 PUSH-THROUGH BLOWER SYSTEM provides same flexibility afforded by system shown in Fig. 4. In both installations, total system static pressure must include static pressure losses through heaters

at 0.5 in. WG, 4.1 bhp is required to handle air at 70 F. However, the brake horsepower varies inversely as the absolute temperature. The corrected brake horsepower can be obtained by multiplying 4.1 by 530 and dividing by 460. The answer is 4.7 bhp.

Admit Makeup Air Only When Exhausting

Outside makeup air need be introduced to the heated space only when the exhaust system is in operation. For this reason, heaters serving a large area are equipped with dampers that permit closing the outside air supply and allow recirculation of the air from the heated space when the exhaust system is not operating. Damper operation can be by:

1) Manual control, which is the least desirable since it is possible to introduce outside air when it is not required.

2) Motorized damper interlocked with a mechanical exhaust fan starter which opens the outside air damper only when the exhaust system is operating. This is a desirable arrangement when the exhaust load is constant.

3) Motorized damper actuated by a pressure sensing device to position the outside air dampers to balance the pressure within the ventilated space. This is a desirable arrangement when the exhaust load is variable and several exhaust fans are used.

In some large installations the heater section may be used without the fan or blower section and may be arranged in banks. A central fan is then used and can be located to blow or pull the air through the heat exchanger sections, as shown in Figs. 4 and 5.

In another article, to appear soon, the subjects of controlling the direct fired heater and sizing the fuel piping systems will be discussed. ≠

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

On Equal Footing, Parties May Contract As They See Fit

CAN A PARTY avoid the responsibility of his own wrongful or negligent acts by prior agreement? It is not uncommon for a contract to include a provision which seeks to limit or avoid the liability for negligence of one of the parties in the performance of the contract. The following case illustrates how a court may look upon such a provision.

Under an agreement with a city government, R. Private Co., a general contractor, was to enlarge and improve a civic center. Private entered into a contract with Flood Bros. whereby Flood was to install an underground piping system for the price of $96,000. Flood was to furnish line and grade stakes, provide a reasonably level working area adjacent to the ditch, do all excavating, and provide all necessary sub-grade and back fill.

Sometime later, R. Private Co. executed its written acknowledgment that Flood's work had been inspected and found complete and satisfactory. However, when Private subsequently refused to pay the $70,000 balance due, Flood Bros. instituted court action.

Private filed a counterclaim for damages against Flood, alleging that Flood had negligently connected pipe to an excessive length. This excessive extension of pipe, he said, had become filled with water during a heavy rain and, in turn, caused a flotation and a loss of much of the back fill, all of which required a relaying of the pipe and replacement of the back fill.

Flood made a motion to dismiss Private's counterclaim:

"Private cannot sue for damages in this case," argued Flood, "because our responsibility under the contract is limited to the replacement of defective work or material. The contract further provides that in no event shall we be liable for consequential damages or claims."

The court found that the contract did so provide and dismissed Private's counterclaim.

Private appealed to a higher court, contending that the provision limiting Flood's liability was invalid. "To allow anyone," said Private, "to be exonerated from liability for his negligence by the terms of a contract is against the public's interest. Further, the provision did not refer to acts of negligence specifically and, therefore, should not be so broadly interpreted."

The higher court expressed its opinion that the parties contracted to limit Flood's liability not only in contract but also in negligence and that the limitation applied no further than the replacement of product or installation where either was defective in quality or workmanship.

"Except where public interest dictates otherwise, it is basic that parties may contract for an exclusive remedy which shall be binding on them," stated the court. "Neither party was in a position to take advantage of the other. They were dealing at arms length and upon equal footing. The contract and its provisions do not violate public policy."

The higher court upheld the lower court's dismissal of Private's counterclaim.

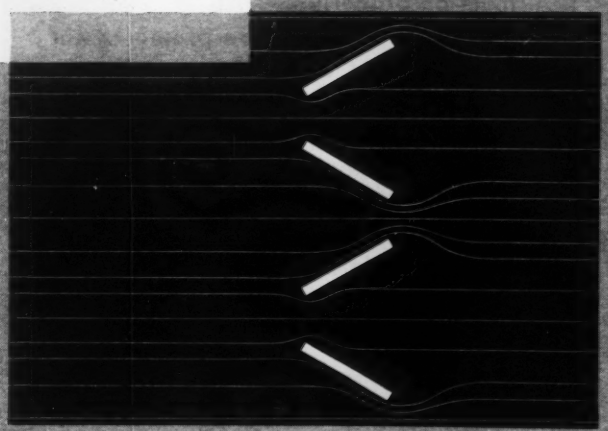
To Private's disadvantage, it can be seen that courts are not inclined to restrict the rights of parties to contract in terms which they see fit. =

HPAC ENGINEERING DATA FILE

How to Select Multiple-Leaf Dampers For Proper Air Flow Control

- How they control air flow
- Pressure loss when full-size
- Pressure loss when undersize
- Selecting face and bypass dampers
- What affects leakage when closed

by Edward J. Brown



"Careful selection and installation of dampers are important for proper control of air flow."

A DAMPER is an air flow control device which is simple in construction and requires very little maintenance. It has no direct connection with the fan and controls air flow by changing the resistance of the duct system. The purpose of this report is to show how damper pressure loss data may be used to determine flow characteristics of dampers installed in various systems. Methods of altering the flow characteristics are discussed and a method of selecting face and bypass dampers to be used in combination with heat transfer coils is also presented.

How the Damper Controls Air Flow

Dampers are used as flow control devices throughout heating and ventilating duct systems. Single-leaf dampers are used in small ducts because of their simple construction. Large dampers are usually of multiple-leaf design to avoid the problem of positioning a large single-leaf against the force of the flowing air.

Multiple-leaf dampers are classified as parallel-leaf or opposed-leaf according to the manner in which the leaves are operated, as shown in Fig. 1. The type of leaf construction shown is used by most damper manufacturers. The crimped leaf edges add strength to the leaves. When closed, the leaves of the damper rest against the stop strips which are attached to the top, bottom, and sides of the damper frame. The stop strips also tend to prevent leakage past the ends of the leaves.

There are no standard dimensions for multiple-leaf dampers. Some manufacturers have

Multiple-leaf dampers of the parallel- and opposed-leaf types are commonly used in air distribution systems to control air volume. Knowledge of the damper's wide open pressure loss and ability to control air flow in a given system is essential if the damper is to function properly.

Pressure loss data are presented for both types of dampers along with information on how to apply these data to determine the degree of control that might be expected. New pressure loss data for sizing face and bypass dampers to obtain equal air volume when either is wide open are also reported.

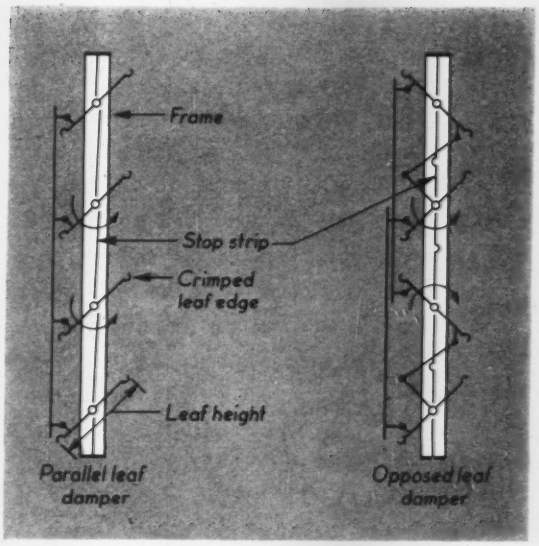
The author, E. J. Brown, is Research Associate in the University of Illinois Mechanical Engineering Department. He was one of the principal investigators for 3½ years on a research project conducted to determine leakage and operating characteristics of multiple-leaf dampers. This study was conducted under the terms of a cooperative agreement between the University's Engineering Experiment Station and the Johnson Service Co. Mr. Brown received his BSME in 1954 and MSME in 1959 from the University of Illinois. He presently is in charge of the University's warm air heating research program and is an associate member of ASHRAE.

achieved a degree of standardization by restricting leaf heights to 6 in., 8 in., 9 in., and 12 in. One or more of these leaves can be placed in a frame to obtain a damper of almost any dimensions.

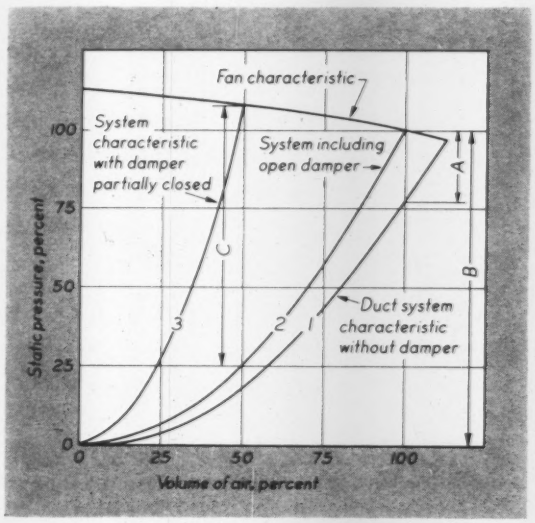
A damper is a control device that varies air flow by changing the resistance of the duct system in which it is installed. Fig. 2 illustrates the relation between the static pressure characteristic of a fan and the pressure loss characteristic of the duct system to which the fan is connected. The intersection of Curve 1 (the duct system curve) and the fan characteristic curve indicates the volume of air that the fan will circulate through the duct system. Curve 2 represents the same duct system with the addition of an open damper. The additional resistance of the open damper decreases the air flow to the quantity indicated by the intersection of the fan characteristic curve and Curve 2. The resistance of the open damper is represented by the quantity *A* in Fig. 2. The resistance of the combined damper and duct system is represented by the quantity *B*.

Partially closing the damper adds more resistance to the system and creates a new system curve (Curve 3). The reduced air flow rate is indicated by the intersection of Curve 3 and the fan curve. In this case the damper has reduced the air flow rate to 50 percent of the maximum air flow.

The resistance of the duct system varies approximately as the square of the volume of air flowing. Therefore, if the air flow rate is reduced to 50 percent of maximum (Curve 3), the resistance of the duct system will be reduced to 25 percent of the value at the maximum air flow rate. The damper must supply all of the additional resistance (the quantity *C*) required to create the new system represented by Curve 3.



1 MULTIPLE-LEAF DAMPERS are commonly constructed as shown here. Parallel-leaf and opposed-leaf designations refer to method of operation. Direction of leaf rotation for each type is indicated



2 A DAMPER controls air flow by varying the resistance of the duct system in which it is installed. Damper movement from the open to a partially closed position increases system resistance and reduces air flow as indicated by new balance point of fan and system curves

Pressure Loss of Multiple-Leaf Dampers

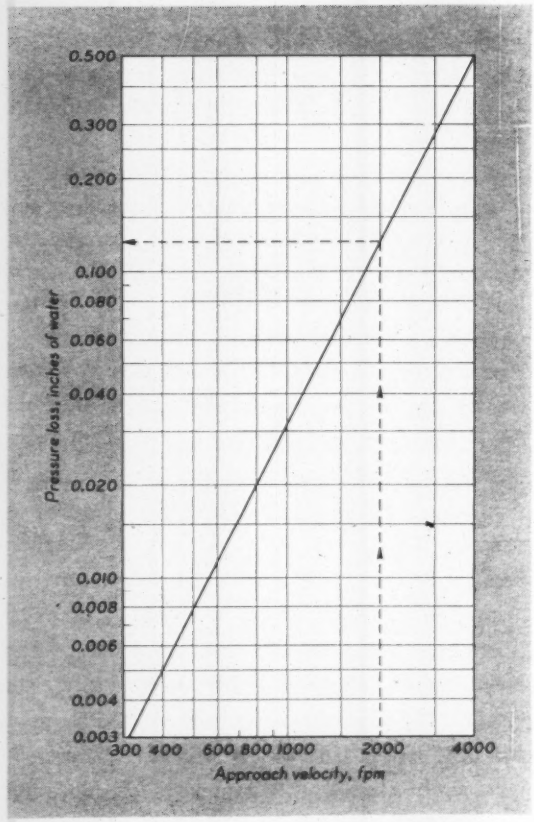
An ideal damper would set up no resistance to air flow when wide open and would supply a substantial amount of resistance to the system upon partial closure to reduce the air flow rate.

The dampers now in common use even when fully open set up some resistance to air flow. Resistance is caused by the damper leaves, the frame members and also by the operating linkage. An investigation[1] of multiple-leaf dampers indicated that for practical purposes the resist-

ance of the open dampers could be expressed as equal to ½ of the velocity pressure of the air stream approaching the open damper.

The pressure loss of open multiple-leaf dampers is given in Fig. 3 and is expressed in terms of inches of water as a function of the approach velocity. The data indicate that the pressure loss caused by the open damper should not be neglected in the calculation of the resistance of the total duct system. The arrows indicate a pressure loss of 0.125 in. of water for an open damper exposed to an approach velocity of 2000 fpm. Fig. 3 is valid for both parallel- and opposed-leaf dampers similar in construction to those illustrated in Fig. 1.

Damper leaf positions are usually expressed in number of degrees from the closed position. Therefore, the closed position is 0 deg and the wide open position is 90 deg. For a given leaf position, other than 90 deg, the pressure loss of an opposed-leaf damper exceeds that of the parallel-leaf damper. For this reason, the reduction of air flow rate for each degree of leaf movement is greater with opposed-leaf dampers than with the parallel-leaf type. The relation between the air flow rate in a given system and damper leaf position is referred to as the damper flow characteristic.[2]



3 PRESSURE LOSSES of wide open parallel- and opposed-leaf dampers of the same area as the duct are given here as a function of the approach velocity (the velocity in the duct upstream from the damper). This loss should be taken into account in design along with the pressure losses of other system components

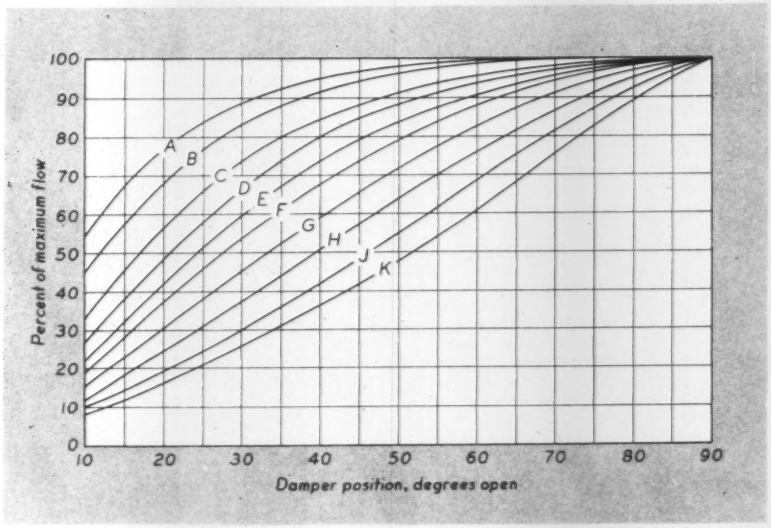
How Air Flow, Damper Position Are Related

The flow characteristic is dependent on the ratio of the damper's resistance when wide open to the resistance of the system in which it is installed. The ratio (*A* divided by *B* in Fig. 2) is an index of the damper's ability to control air flow. If the damper resistance is a large percentage of the system resistance, any change in damper position will alter the system resistance sufficiently to vary the air flow rate. If the damper resistance is a minor part of the total system resistance, a substantial change in damper position is required to vary the air flow.

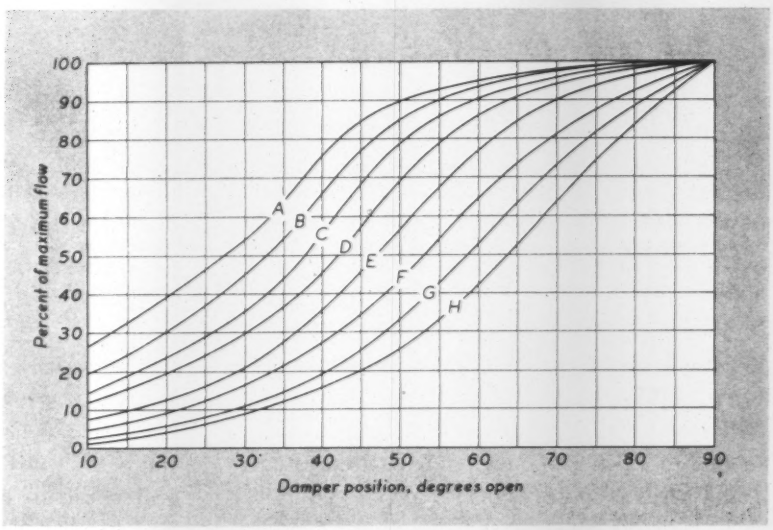
Flow characteristics for parallel-leaf dampers are shown in Fig. 4. Curve *A* represents a poor flow characteristic since practically no reduction in air quantity results as the damper is closed from the 90 deg to the 60 deg position. Curve *J* represents a nearly linear flow characteristic in that air flow is reduced directly in proportion to damper movement. This is a desirable characteristic. Opposed-leaf damper flow characteristics are shown in Fig. 5. A linear flow characteristic would lie between Curves *D* and *E*.

The curves in Figs. 4 and 5 are terminated at the 10 deg damper position since at 0 deg the flow would be reduced to zero flow only by a damper that was absolutely tight at the 0 deg position. Multiple-leaf dampers are not usually constructed to positively prevent leakage past

[2]*Numerals refer to references listed on page* 178.



4 PARALLEL-LEAF damper flow characteristics show air flow that will be obtained at various damper positions when constant system pressure is maintained. Ratios of wide open damper-to-system pressure loss for which characteristics apply are given in Table 1



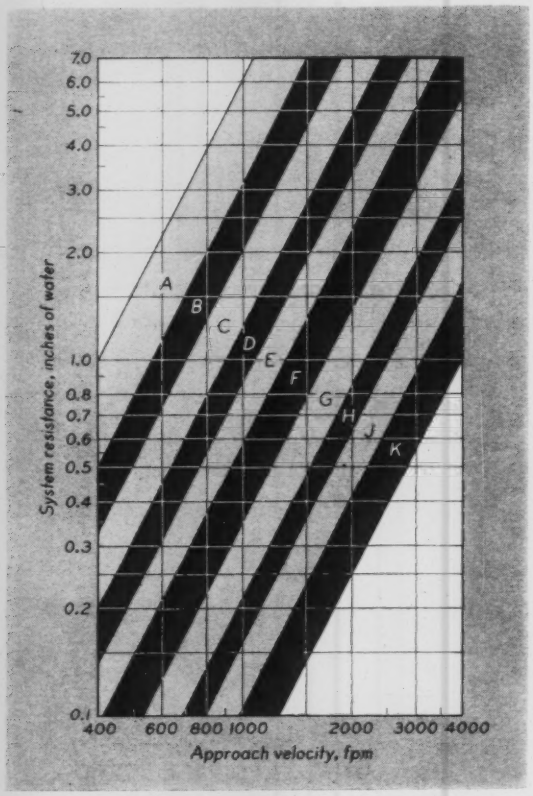
5 OPPOSED-LEAF damper flow characteristics shown here differ from those for parallel-leaf dampers given in Fig. 4. Damper-to-system pressure loss ratios of Table 1 show that opposed-leaf damper has a better characteristic for the same ratio of pressure loss

the closed leaves. Leakage at the 0 deg position cannot be determined from the flow characteristics of Figs. 4 and 5.

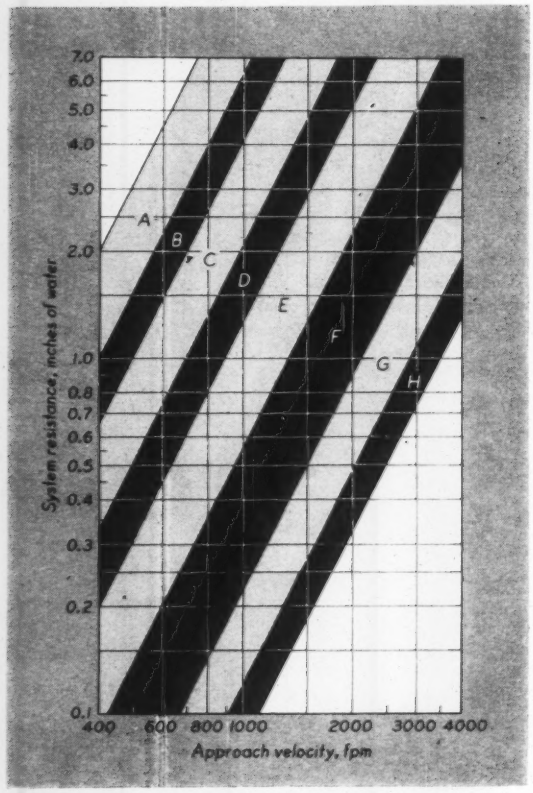
In Table 1 are listed the open damper resistances as percentages of the system resistances which apply to each of the flow characteristics in Figs. 4 and 5. Comparison of the damper-to-system resistance percentages indicates that the opposed-leaf dampers produce better flow characteristics than parallel-leaf dampers for a given percentage of damper-to-system resistance. For example, to produce a linear flow characteristic, the open parallel-leaf damper must be from 20

TABLE 1 — RATIOS of damper resistance to system resistance which apply to flow characteristic curves of Figs. 4 and 5

Parallel-leaf dampers		Opposed-leaf dampers	
Open damper resistance, percent of system resistance	Flow characteristic curve	Open damper resistance, percent of system resistance	Flow characteristic curve
0.5 — 1.0	A	0.3 — 0.5	A
1.0 — 1.5	B	0.5 — 0.8	B
1.5 — 2.5	C	0.8 — 1.5	C
2.5 — 3.5	D	1.5 — 2.5	D
3.5 — 5.5	E	2.5 — 5.5	E
5.5 — 9.0	F	5.5 — 13.5	F
9.0 — 15.0	G	13.5 — 25.5	G
15.0 — 20.0	H	25.5 — 37.5	H
20.0 — 30.0	J		
30.0 — 50.0	K		



6 PARALLEL-LEAF DAMPER flow characteristic can be found from this chart when approach velocity and total system static pressure loss are known. Letters correspond to those of Fig. 4



7 OPPOSED-LEAF DAMPER flow characteristic can be found from this chart when approach velocity and total system static pressure loss are known. Letters correspond to those of Fig. 5

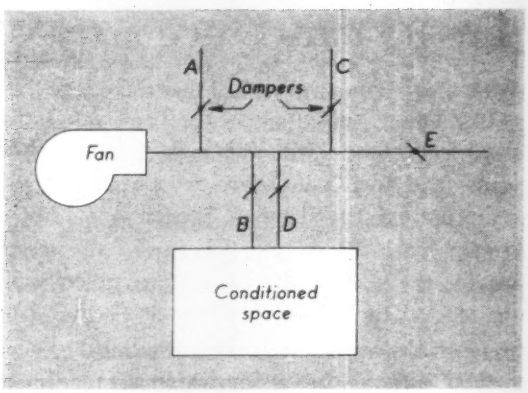
to 30 percent of the total system resistance (see Curve *J*, Fig. 4). A similar flow characteristic will result with an opposed-leaf damper that is from 2 to 5 percent of the total system resistance (see Curves *D* and *E*, Fig. 5).

The conditions necessary for the flow characteristics to exist may also be expressed in terms of overall system resistance and approach velocity as in Figs. 6 and 7 which show bands for each of the flow characteristics of Figs. 4 and 5, respectively. Each band covers a range of approach velocities and system resistances that must exist for the corresponding flow characteristic labeled with the same letter. For example, a parallel-leaf damper installed in a system with any combination of velocity and system resistance which falls within band *A* of Fig. 6 will have a flow characteristic represented by Curve *A* of Fig. 4.

The flow characteristics are strictly applicable only to systems in which the fan has a *flat*, or *nearly flat* pressure characteristic. That is, the fan would deliver constant pressure from 0 to 100 percent flow. However, the curves present a general picture of the flow characteristics of parallel- and opposed-leaf dampers. Particularly, the curves illustrate that, for a given set of conditions, a better characteristic may be expected with an opposed-leaf damper than with a parallel-leaf damper.

One example of where the flow characteristics may be applied is to a damper in a branch duct of a large system. Such a system is illustrated in Fig. 8.

Assume that a parallel-leaf damper is installed in branch duct A. The full-flow velocity in branch A is 1500 fpm. The static pressure at the branch duct inlet is 1.5 in. of water and is assumed to remain constant regardless of the flow in the branch duct. In this case, the system con-



8 FLOW CHARACTERISTICS can be used to determine whether mechanically linked dampers will provide constant air flow to conditioned space in systems such as one shown here

sists of the branch duct and any equipment such as coils, filters, and the damper included in the duct. The system resistance is equal to the static pressure of 1.5 in. of water. The questions to be answered are:

1) What flow characteristic will result from these conditions with a parallel-leaf damper?

2) If the parallel-leaf damper is replaced with an opposed-leaf damper, what flow characteristic will result?

Referring to Fig. 6, the velocity and system resistance conditions fall within the region covered by band *E*. Therefore, the flow characteristic for a parallel-leaf damper in this system is represented by Curve *E* of Fig. 4.

Referring to Fig. 7, the velocity and system resistance conditions again lie under band *E*. The opposed-leaf damper flow characteristic is represented by Curve *E* of Fig. 5. The opposed-leaf damper flow characteristic is more desirable than the parallel-leaf characteristic under identical conditions.

Another question that must often be answered is, what results can be expected when dampers in two ducts served by the same fan are linked together mechanically? Assume that ducts B and D in Fig. 8 are identical branch ducts and each contains, along with other equipment, an opposed-leaf damper. The ducts are of 1 sq ft area and so designed that a full flow of 1500 cfm in either one will result in a branch pressure loss of 1.5 in. of water. The ducts serve the same space and are to supply a constant 1500 cfm to the space. Damper B and damper D are linked mechanically in such a way that if one is open the other is closed and damper B always moves the same number of degrees as damper D. Will this arrangement insure that 1500 cfm will always flow through the ducts to the space served if the static pressure at the entrances to ducts B and D is assumed constant at 1.5 in. of water?

The conditions of 1500 fpm and 1.5 in. of water system pressure loss indicate a flow characteristic for each damper that is represented by Curve *E* of Fig. 5. If either damper is wide open the other will be fully closed and 1500 cfm will flow in the space.

If damper B was 60 deg open then damper D would be 30 deg open. The flow characteristic indicates that duct B would carry 77 percent and duct D would carry 20 percent for a total of 97 percent of the required 1500 cfm.

If each damper were set at 45 deg, each duct would carry 45 percent of the maximum flow for a total of 90 percent of the maximum flow. Under this condition the total flow delivered to the space would be 1350 cfm. Flow characteristic *E* approaches a linear characteristic and the deviation from the desired air flow rate would not decrease below 90 percent of the required 1500 cfm. Control of the total volume of air would not be as close with a damper having a nonlinear flow characteristic.

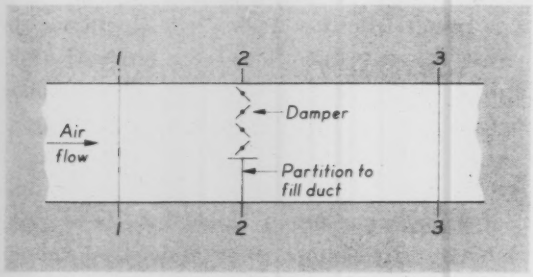
If the two dampers used had been parallel-leaf dampers the results would have been quite different. With damper B at 60 deg and damper D at 30 deg, 90 percent of the maximum volume would flow through duct B and 60 percent would flow through duct D for a total of 150 percent or 2250 cfm. With each parallel-leaf damper set at 45 deg, each duct would deliver 80 percent of maximum for a total flow of 2400 cfm.

To be successfully linked together, under the above described conditions, two dampers must have linear flow characteristics to provide an approximately constant air flow rate. The combinations of identical duct systems and linear flow characteristics would rarely be encountered. For this reason, mechanically linked dampers in parallel ducts cannot be relied upon to provide a constant air flow rate.

Pressure Loss, Face Area Less Than Duct Area

Up to this point, only those dampers with face area equal to the duct cross-sectional area have been considered. In some installations two dampers may be placed side-by-side, as is the case with face and bypass dampers. One of these dampers may be required to remain open while the other is fully closed. The question then arises as to what pressure loss occurs through the single open damper. It is not the same as the loss through an open damper with face area equal to the duct cross-sectional area.

Fig. 9 illustrates an opposed-leaf damper installation with a face area less than the duct cross-sectional area. The area not occupied by the damper is filled with a sheet metal partition. A study of the pressure loss of damper and partition combinations was included in the investigation of multiple-leaf dampers conducted at the University of Illinois. The results of these studies have not been published previously.



9 DAMPER-PARTITION arrangement illustrated here was used to measure pressure losses of dampers having a face area less than the cross-sectional area of the duct in which they are installed

TABLE 2 — FACTORS by which full-sized opposed-leaf damper flow characteristic must be multiplied to obtain the flow characteristic for a similar damper with face area equal to 75 percent of the duct cross-sectional area listed here show relatively small improvement that can be made by decreasing damper size

Full-size damper flow characteristic	Undersize damper position, degrees open			
	90	70	50	30
A	0.98	1.0	1.0	1.0
B	0.98	1.0	1.0	1.0
C	0.97	0.98	0.99	1.0
D	0.96	0.97	1.0	1.0
E	0.93	0.95	1.0	1.0
F	0.87	0.88	0.90	0.94
G	0.77	0.82	0.88	0.90
H	0.65	0.75	0.89	0.89

In Fig. 9, Section 1 is upstream from the damper-partition combination where the flow across the duct is uniform. Section 2 is at the centerline of the damper. Section 3 is downstream from the damper where the air stream leaving the duct has expanded to completely fill the duct. The average velocity at Section 3 is equal to the average velocity at Section 1.

The pressure losses, exclusive of the losses due to friction between the air and the duct wall, which occur between Sections 1 and 3, are as follows: a pressure loss due to contraction of the air stream from the duct area at Section 1 to the damper flow area at Section 2, a friction loss as the air flows over the damper leaves at Section 2, and a loss due to abrupt expansion of the air stream from the damper flow area to the full duct cross-section at Section 3. These losses can be most conveniently expressed as a sum of the three losses between Sections 1 and 3.

A summary of the pressure losses caused by combinations of open dampers and partitions as determined in the University of Illinois investigation is given in Fig. 10. Pressure loss in inches of water is plotted as a function of approach velocity in fpm (velocity at Section 1, Fig. 9). The curves are for damper face area-to-duct area ratios from 0.1 to 1.0 and apply to both parallel- and opposed-leaf dampers.

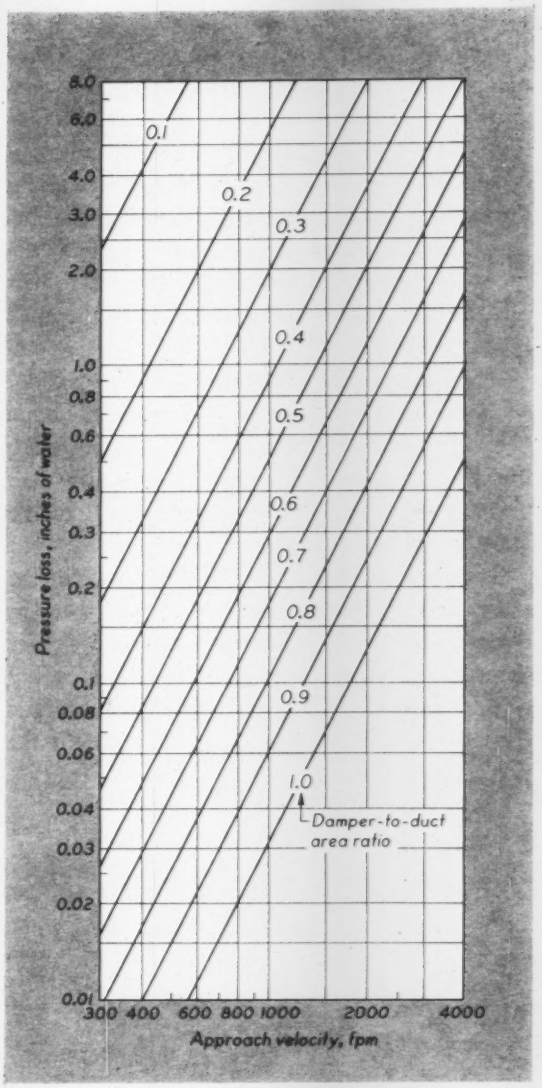
As noted earlier, multiple-leaf dampers are not manufactured in standard sizes. The dampers can be ordered to fit almost any duct. The possibility exists of standardizing on certain damper dimensions. Dampers for ducts of other than standard dimensions could be furnished with partitions to fill the space not occupied by the damper. However, the use of the partitions would increase the loss of the open dampers. For example, an open damper and partition combination with damper-to-duct area ratio of 0.9 would have a pressure loss equal to twice that of a full-size open damper (See Fig. 10). With 1000 fpm approach velocity, the loss through the full-size damper is 0.031 in. of water, but

with the same approach velocity, the loss through the damper-partition combination with 0.9 area ratio is 0.062 in. of water. With lower velocities the same ratios of increased pressure losses would prevail but the magnitude of the losses would be decreased. For example, with a 600 fpm approach velocity, the pressure loss for a 0.9 area ratio is 0.022 in. of water as compared with 0.011 in. of water for a full-size damper.

The damper-partition arrangement could be used to standardize damper sizes in systems where the damper resistance is a relatively small part of the system resistance.

The installation of a damper and adapter plate will result in an improved damper flow characteristic provided that the damper-to-system resistance ratio is increased. To illustrate, multiplying factors to be applied to the opposed-leaf damper flow characteristics shown in Fig. 5 are listed in Table 2 for a damper with face area equal to 75 percent of the duct cross-sectional area. For a damper of this size installed in place of a full-size damper, the percentages of maximum flow at the indicated leaf positions are obtained by multiplying those for a full-size damper by the factors in Table 2. The table values show that the undersize damper causes very little change in the flow characteristics except in cases where the full-sized damper has already provided a desirable flow characteristic. Improvement of the flow characteristic is accompanied by a reduction in the maximum flow.

For these reasons, an undersize damper will not always result in an improved flow characteristic. In some cases, where the full-size damper constitutes a very small part of the resistance, it would be necessary to reduce the damper face area to as little as 25 percent of the duct cross-sectional area before an improved flow characteristic would result. The factors to be applied for this reduction in damper size would differ from those listed in Table 2.



10 PRESSURE LOSS of wide open parallel- and opposed-leaf dampers of face area less than the duct area is given here as a function of the velocity in the duct just upstream (Station 1, Fig. 9) from the damper-partition combination

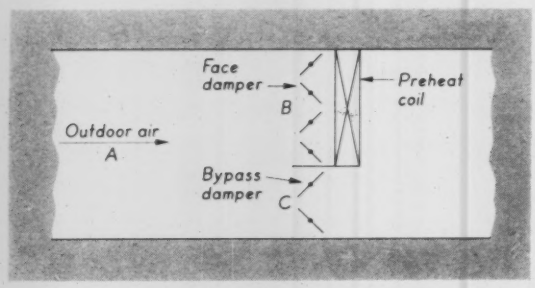
Selecting Face and Bypass Dampers

Face and bypass dampers are usually equipped with a mechanical linkage that will cause the face damper to be open when the bypass damper is closed and vice versa. Such an arrangement is shown in Fig. 11. In the system illustrated, the outdoor air at section *A* is to be passed through the preheat coil at *B* or bypassed around the coil through bypass damper

C, depending upon the temperature of the air at section *A*. The dampers are often used as a modulating control to maintain a preset constant air temperature downstream from the preheat coil. In some cases, the air temperature is controlled by means of a modulating valve on the preheat coil in conjunction with face and bypass dampers. With either control system, the face and bypass dampers must be selected to permit full flow, either through the coil or the open bypass damper.

In an installation such as that shown in Fig. 11, to assure that the air flow through the open face damper and coil will equal that through the open bypass damper, the pressure loss through the open bypass must be equal to the loss through the face damper and coil.

The pressure losses may be equalized for the same air flow rates if the proper face damper-to-duct area ratio is selected. The open face damper and closed bypass or the open bypass and closed face damper are equivalent to the damper-partition combinations discussed in the preceding section.



11 FACE AND BYPASS DAMPERS must be selected to achieve the same air flow with either damper in wide open position. Installation, as shown here, is similar to damper-partition combination of Fig. 9

TABLE 3 — VELOCITY through open bypass damper in fpm for various face damper-to-duct area ratios and open face damper velocities is given here

Open face damper velocity, fpm	Open bypass damper velocity, fpm, for these ratios of face damper area to duct area								
	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55	0.50
300	2700	1700	1200	900	700	560	450	365	300
400	3600	2265	1600	1200	935	740	600	490	400
500	4500	2835	2000	1500	1070	930	750	610	500
600	5400	3400	2400	1800	1400	1110	900	735	600
700	6300	3970	2800	2100	1630	1300	1050	855	700
800	7000	4530	3200	2400	1870	1485	1200	980	800
900	8100	5100	3600	2700	2100	1670	1350	1100	900
1000	9000	5670	4000	3000	2340	1855	1500	1220	1000

The face and bypass damper selection procedure presented below assumes that all of the air flows through either the face damper or through the bypass. The selection of the proper damper-to-duct area ratio is dependent on matching the combined loss of the coil and open face damper to the loss of the open bypass damper.

Fig. 12 shows the pressure losses of damper-partition combinations rearranged with the pressure losses plotted as a function of the damper face velocity (velocity at section *B* or *C* in Fig. 11). The range of velocities is from 200 to 4000 fpm. Curves are given for damper-to-duct area ratios from 0.1 through 0.9. This is sufficient for the full range of coil face velocities given in the ASHAE *Guide*,[3] which range from 300 to 800 fpm with 500 fpm as a common value.

Open bypass damper velocities that will result if the full air flow is diverted through the bypass are listed in Table 3 for various open face damper velocities and face damper-to-duct area ratios between 0.55 and 0.90. As an example, assume that the face damper-to-duct area ratio is 0.80 and the open face damper velocity is 500 fpm. The bypass velocity would then be 2000 fpm.

The procedure for selecting the correct face damper-to-duct area ratio is as follows:

1) Determine the velocity through the open face damper which will be equal to the coil manufacturer's recommended coil face velocity.

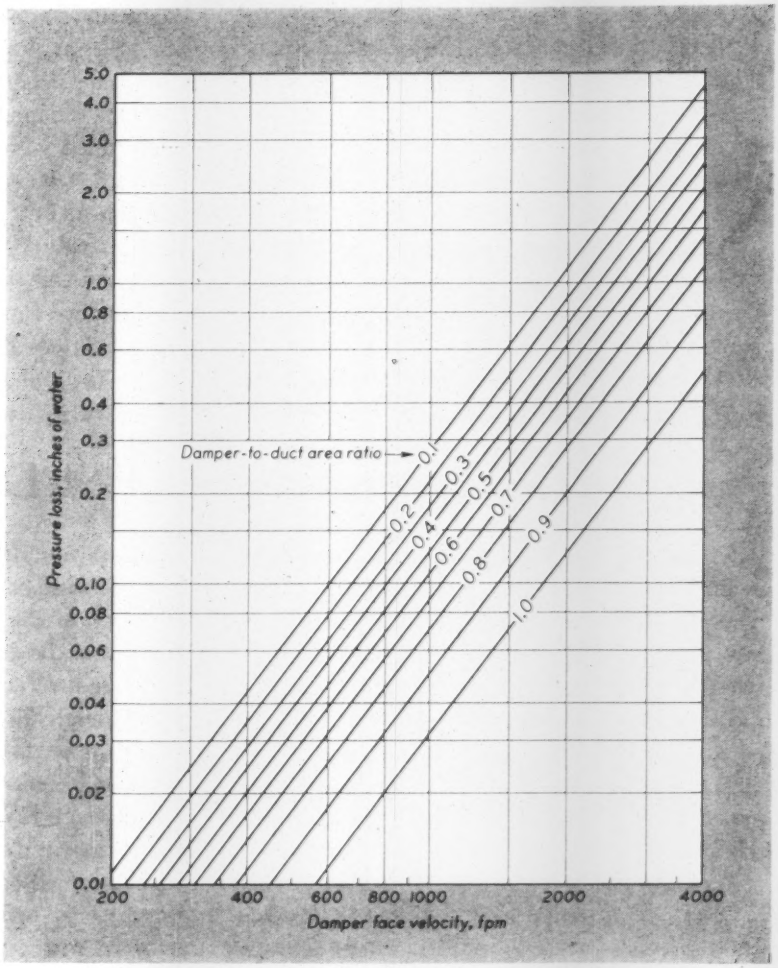
2) Assume a face damper-to-duct area ratio. The bypass damper-to-duct area ratio is 1.0 minus the face damper-to-duct area ratio.

3) From Fig. 12 determine the face damper pressure loss and add this to the coil pressure loss.

4) From Table 3 determine the open bypass velocity.

5) From Fig. 12 determine the loss of the open bypass damper and compare it with the combined loss of the face damper and coil. If the losses are equal the bypass is properly sized.

6) If the loss of the bypass is greater than that of the face damper and coil, try a larger bypass damper and repeat the procedure. If the loss of the bypass is less than that of the face



12 PRESSURE LOSS of wide open face or bypass dampers can be determined from this chart when ratio of damper area to duct area and damper face velocity are known. Bypass damper face velocities for various combinations of face damper area and velocity are given in Table 3

damper and coil, try a smaller bypass damper and repeat the procedure.

An example will help to clarify the procedure. Assume that a preheat coil is to be equipped with a face and bypass damper. With a face velocity of 500 fpm the pressure loss through the coil is 0.40 in. of water. Select a face and bypass damper such that with the total air flow diverted through the open bypass the pressure loss will be equal to the loss through the open face damper and coil.

Trial 1

1) The velocity through the open face damper is 500 fpm.

2) Assume a face damper-to-duct area ratio of 0.8 which dictates that the bypass damper-to-duct area ratio will be 0.2.

3) From Fig. 12 the pressure loss of the open face damper is 0.017 in. of water. Added to the coil loss, the total loss is 0.417 in. of water.

4) From Table 3, the velocity through the open bypass damper is 2000 fpm.

5) The loss of the open bypass damper is 0.86 in. of water as determined from the intersection of the 0.2 damper-to-duct area ratio curve and the 2000 fpm line.

6) The loss is almost twice that of the face damper and coil which means that a larger bypass damper area is required.

Trial 2

1) The face damper velocity will be 500 fpm as before.

2) Assume a face damper-to-duct area ratio of 0.75.

3) The loss of the open face damper — Fig. 12 — is 0.019 in. of water. The combined damper and coil loss is 0.419 in. of water.

4) The bypass velocity from Table 3 is 1500 fpm.

5) The loss through the open bypass is 0.44 in. of water.

6) The bypass loss is within 5 percent of the combined loss of the face damper and coil. Therefore, the bypass for practical purposes is properly sized.

This selection procedure considers only the open position of either the face or the bypass damper. Determination of the flow characteristics has not been included. Actually, with the dampers partially open the flow characteristic problem is similar to that discussed for the adjacent ducts with a mechanical link between the dampers. Unless the face and bypass dampers have linear flow characteristics, the total flow in the duct will not remain constant as one damper is opened and the other closed. However, when the principal function of the dampers is to either allow full flow through the coil or to completely bypass the coil, the flow characteristics are not important.

Leakage through Closed Dampers

Leakage through closed dampers was included in the University of Illinois investigation. It was determined that the leakage could be separated into three components, which were: leakage between adjacent leaves, leakage past the ends of the leaves, and leakage between the lengthwise edge of the leaf and the damper frame.

The leakage between adjacent leaves may be kept to a minimum by proper adjustment of the damper linkage to provide tight closure.

Leakage past the ends of the leaves is controlled by stop strips (See Fig. 1). If the stop strips are not provided, a gap is left between the damper leaves and the frame which allows a considerable amount of leakage to occur. Stop strips are a necessity if the damper is to be used as a no-flow device when closed. When specifying dampers, a minimum acceptable rate of leakage should be stated since it is not practical to make dampers of this construction air tight.

The leaf length was found to be critical in the prevention of leakage between the lengthwise edge of the leaf and the damper frame. Leaves of 16 gauge metal, greater than 3 ft long, and shaped as shown in Fig. 1 bow away from the damper frame when closed and subjected to a pressure difference of more than 2.0 in. of water. Thus, long damper leaves should not be used unless they are especially strengthened to resist bending.

The installation of the damper in the duct should also be given careful attention to decrease leakage. Damper outside frame dimensions are usually 1/4 in. less each way than the duct dimensions to allow clearance for the installation of the damper. If the gap between the frame and the duct walls is not sealed, the leakage past the frame may be greatly in excess of that through the closed damper.

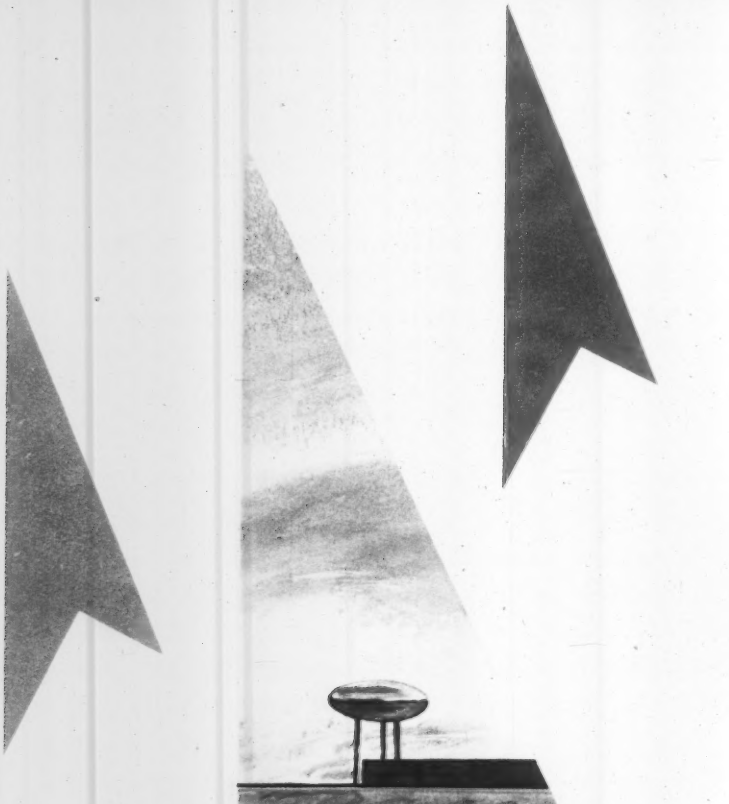
A damper should not be installed without considering its effect on the system. The pressure loss through the open damper must be included in the system design in the same way as the resistance of other system components such as fittings, coils, or filters. Flow characteristics of dampers may range from very poor to excellent depending upon the damper-to-system resistance ratio. Flow characteristics may be altered to some extent by the installation of an undersize damper. However, the flow characteristic of the undersize damper is also dependent upon the damper-to-system resistance ratio. A wide open bypass damper, if properly selected, will carry the same volume of air as an open face damper-coil combination and with an equal pressure loss. Careful selection and installation of dampers is important for the proper control of air flow.

References

1) Brown, E. J., and Fellows, J. R., "Pressure Losses and Flow Characteristics of Multiple-Leaf Dampers," ASHAE *Transactions*, Vol. 64, 299 (1958).

2) Dickey, P. S., and Coplen, H. L., "A Study of Damper Characteristics," ASME *Transactions*, Vol. 64, 137-154 (1942).

3) *Heating Ventilating Air Conditioning Guide*, 1958, Chapter 23, American Society of Heating and Air-Conditioning Engineers.



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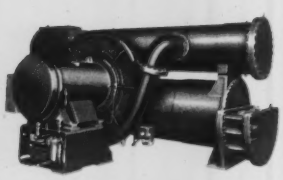

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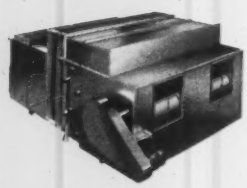

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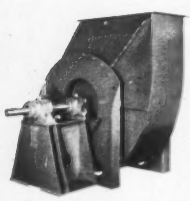

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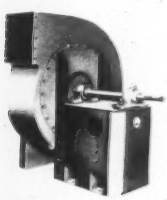

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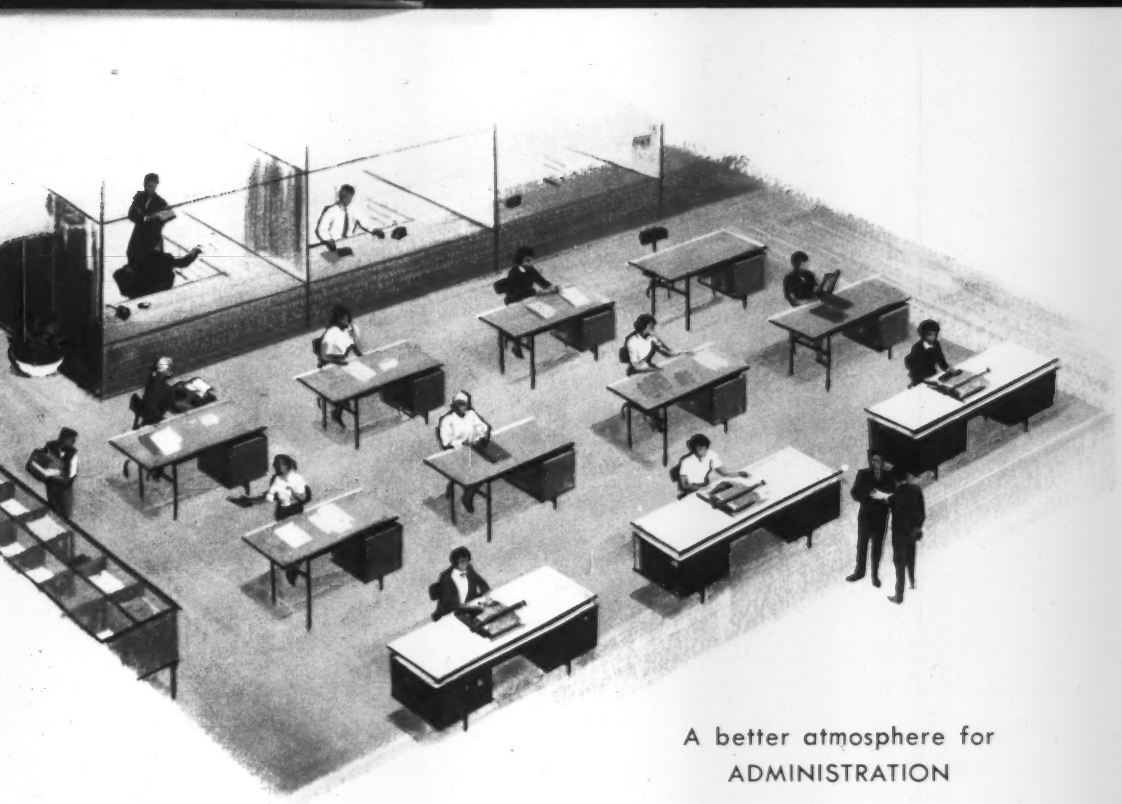

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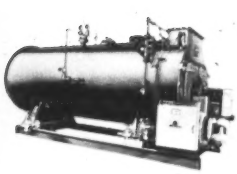

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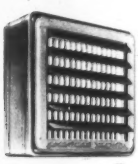

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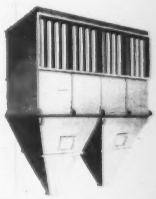

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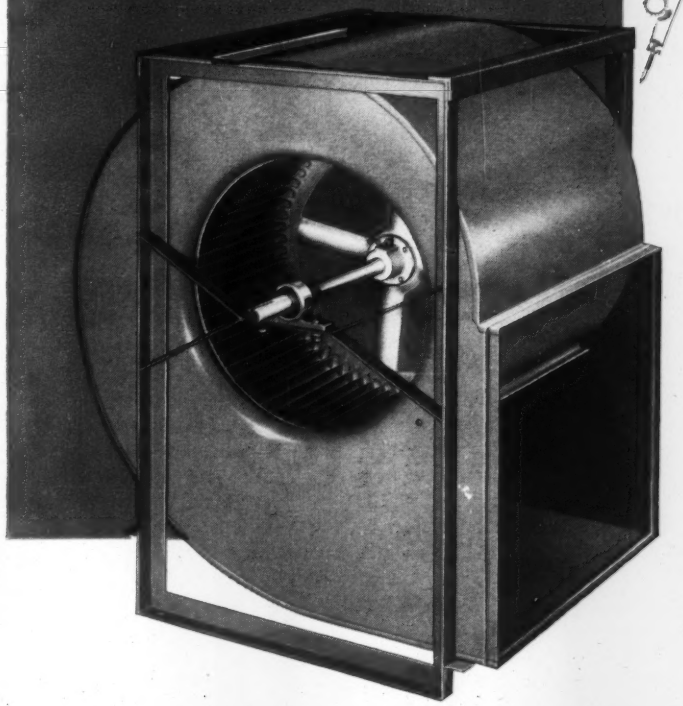

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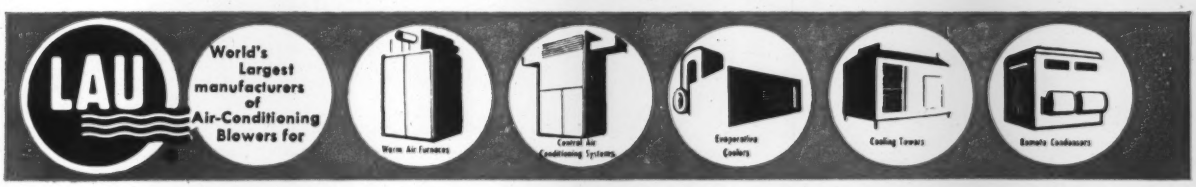

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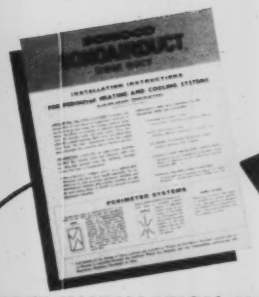

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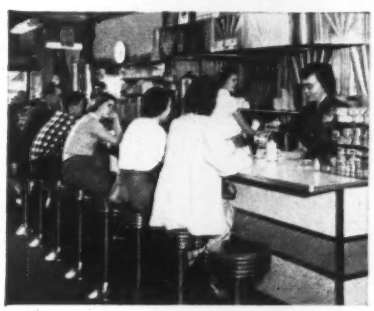

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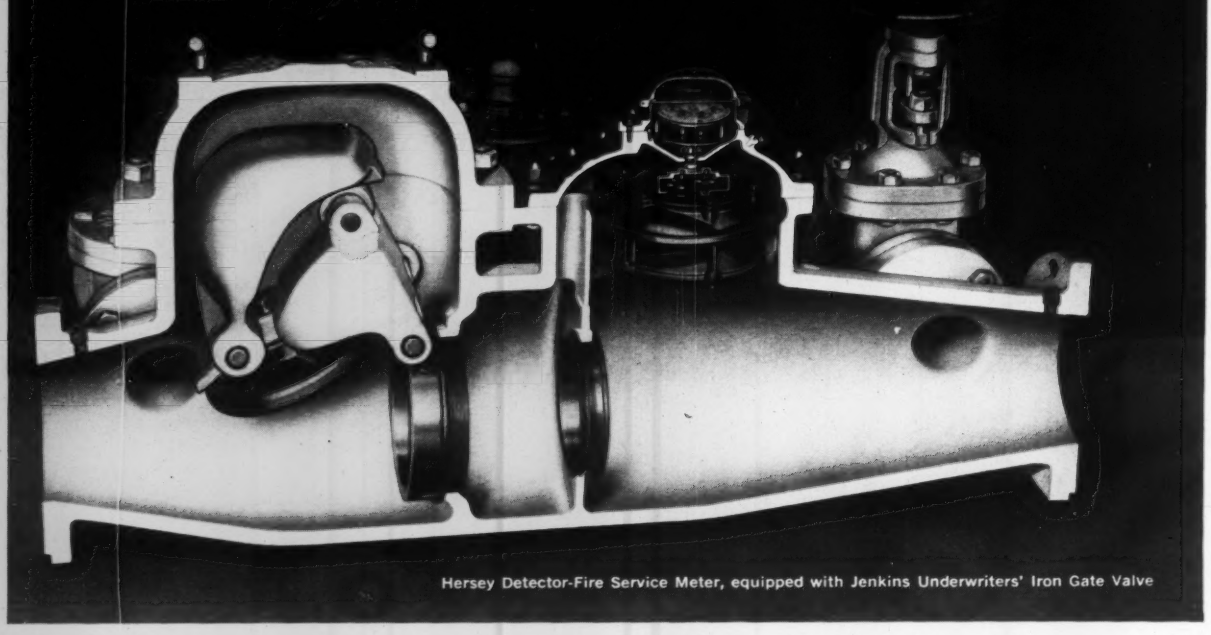

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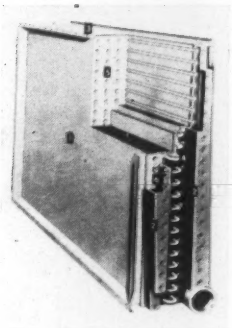

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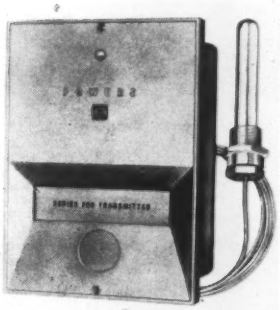

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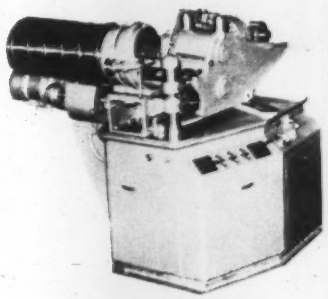

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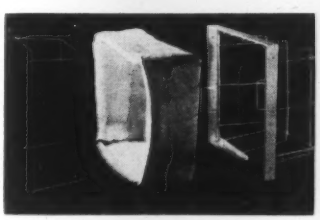
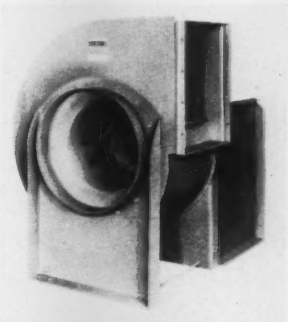


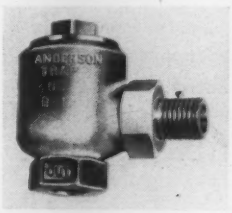
Air Filter . . .

. . . disposable type, rated UL Class II, constructed as open-side cube for greater surface area, furnished with basket and retainer wire in standard face area sizes and 8, 11, or 20 in. depths; 20 by 20 by 20 in. element is rated at 0.04 in. pressure drop at 2000 cfm, according to manufacturer —*Union Carbide Development Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York* 17, *N.Y.*



Centrifugal Blower . . .

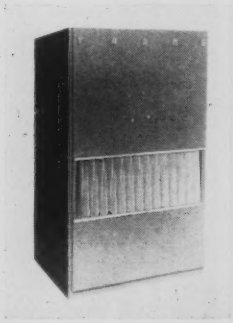
. . . in 12 sizes from 688 to 23,000 cfm capacity, belt driven, has rubber-mounted motors and fan bearings; optional features include weather cover, housing access door, various corrosion resistant paints; catalog "3401" available on request—*Ilg Electric Ventilating Co.*, 2850 *N. Pulaski Rd., Chicago* 41, *Ill.*



Steam Trap . . .

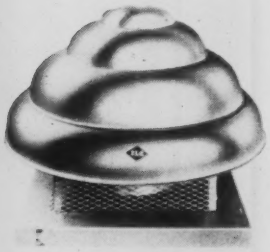
. . . thermostatic, with integral inlet union, in 1/2 and 3/4 in. sizes; for discharge of 31,000 lb of condensate per hr at pressures to 250 psi, equipped with bronze bodies, alloy valve and seat, operates under constant spring load—*V. D. Anderson Co.*, 1935 *W 96th St., Cleveland* 2, *O.*

EQUIPMENT DEVELOPMENTS
Continued



Heat Pump . . .

. . . water-to-air, in five sizes — 3, 5, and 7½ ton single compressor and 10 and 15 ton dual compressor units with heating capacities of 49,000 to 206,000 Btu per hr; features horizontal or vertical discharge, reversing valve for heating/cooling cycling, slow speed fans—*The Trane Co., La-Crosse, Wis.*



Roof Ventilators . . .

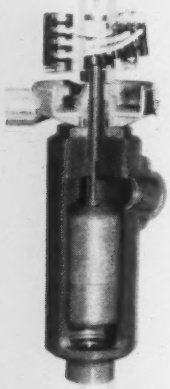
. . . powered, centrifugal, in 11,000 to 29,790 cfm capacities, with spun aluminum housing, steel base, direct-drive fan; feature low silhouette, self-cooling motor construction, according to manufacturer; bulletin "2701-S" available on request—*Ilg Electric Ventilating Co.*, 2850 *N. Pulaski Rd., Chicago* 41, *Ill.*

Absorption Machines . . .

. . . in 50 to 1000 ton capacities, 20 sizes, feature new solution valve control system for more efficient partial-load operation and less scaling; operates on 12 psi steam pressure, may be controlled remotely—*Carrier Corp., Carrier Parkway, Syracuse* 1, *N.Y.*

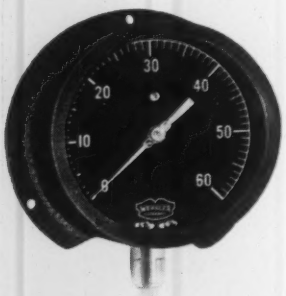
Dust Collector . . .

. . . for use in small, light dust producing operations, requires 12 by 14 in. floor area, is 21-½ in. high; uses throwaway glass filter, 1/3 hp motor—*Torit Mfg. Co.*, 1133 *Rankin St., St. Paul, Minn.*



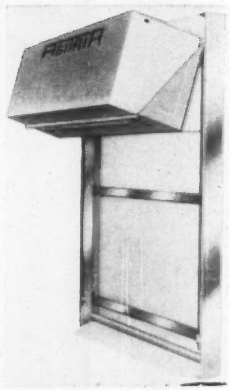
Liquid Level Control . . .

. . . for use with any liquid of specific gravity of 0.70 or above has polyvinyl chloride construction of all parts in contact with liquid; chamber and float construction designed for 100 psi at 70 F or 50 psi at 140 F—*Magnetrol, Inc.*, 2110 *S. Marshall Blvd., Chicago* 23, *Ill.*



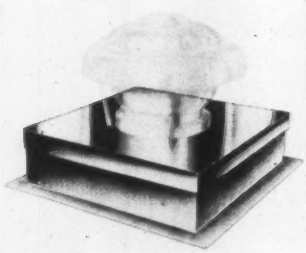
Pressure Gage . . .

. . . in 3½, 4½, 6, and 8½ in. dials, with aluminum, phenol, iron, or brass cases, Bourdon tubes of various alloys and stainless steel; for 0 to 10,000 psi pressures, 15 to 2500 psi with chemical diaphragm; vacuum gages in same line are available with 0 to 30 in. Hg capacities—*Weksler Instruments Corp.*, 195 *E. Merrick Rd., Freeport, N.Y.*



Manual Air Filter . . .

. . . for commercial and industrial applications utilizes nominal 2 in. thick glass fiber medium; available in overall heights from 6 to 12 ft in 4 in. increments, widths from 3 to 20 ft; catalog "DS-100" available on request—*Air Devices Inc.*, 185 *Madison Ave., New York* 16, *N.Y.*



Ventilator Curb . . .

. . . for noise control in direct overhead installations, produces speed reduction equivalent of 43 percent of actual speed with 10 percent reduction of air flow, according to manufacturer; available in four sizes, in heights of 6 to 12 in.—*Jenn-Air Products Co., Inc.*, 1102 *Stadium Drive, Indianapolis, Ind.*

Boiler Alarm . . .

. . . combines float action and electrode-operated functions in single water chamber; can be used for fuel cut-out and low alarm, dual fuel cut-out, or dual fuel cut-out and low alarm; for pressures to 350 psi or 650 psi in tank service; catalog "D2.5" available on request—*The Reliance Gage Column Co.*, 5902 *Carnegie Ave., Cleveland* 3, *O.*

EXPANSION JOINTS

How to keep your cost accountant contented

Just ask him to amortize the cost of a U.S. Rubber Expansion Joint.

He will have a pleasant time discovering that these joints never seem to wear out. Some have been in use for 30 years and are as sturdy as ever. No other rubber expansion joints have been in use that long.

"U.S." Expansion Joints are the only joints that have withstood this test of time. As for value, "U.S." Expansion Joints remain the cost accountant's delight. Other so-called "just-as-good" joints costing a few dollars less can rob you of many times their complete cost when they cause downtime.

Your accountant will tell you that "U.S." Expansion Joints comprise shrewd, logical insurance. These joints are the economical, flexible connections used in all kinds of pipe lines to take care of misalignment, vibration, expansion, contraction and noise transmission. No moving parts to wear or bind; can be installed on new or old equipment.

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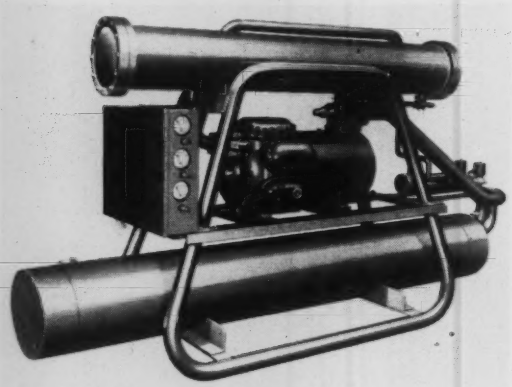
EQUIPMENT DEVELOPMENTS

Continued

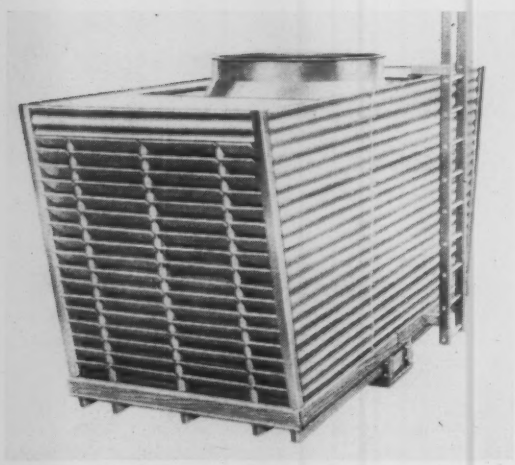


Reciprocating Chiller . . .

. . . in 10 sizes, 10 to 100 ton capacities, with hermetic compressor, direct expansion evaporator, shell-and-tube condenser; available with pneumatic or electric controls, factory-wired control panel; all models said to pass through 36 in. door—*The Trane Co., LaCrosse, Wis.*

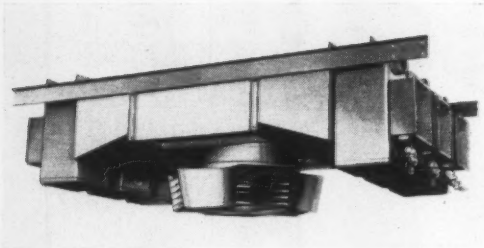
Air Cooled Condenser . . .

. . . featuring vertical discharge; individual units designed for applications from 5 to 40 tons, feature slow speed belt driven fans and internally mounted motors—*Recold Corp., 7250 E. Slauson Ave., Los Angeles 22, Calif.*



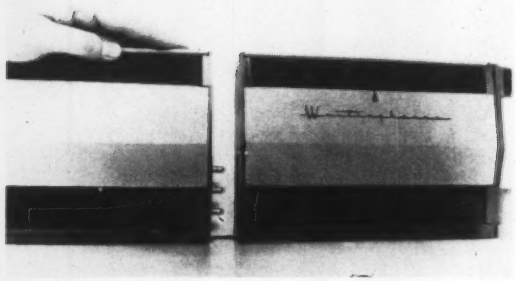
Cooling Tower . . .

. . . in two series, featuring tapered design, canted collecting pans and depressed center sump; laminated wood panels said to be stronger and lighter, adjustable pitch fan powered by sealed motor; removable access panels—*J. F. Pritchard & Co., 4625 Roanoke Parkway, Kansas City 12, Mo.*



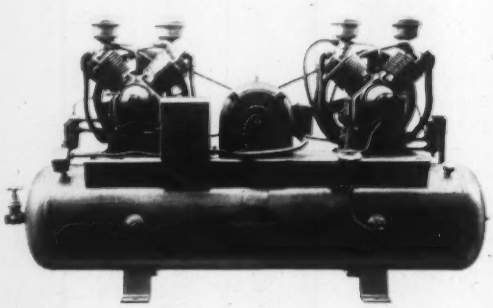
Space Heater . . .

. . . gas fired, consists of 2, 4, or 6 duct heaters with plenum chamber, fan, and fixed or revolving discharge unit; available in five sizes from 368,000 to 1,104,000 Btu per hr; 4 revolving and 4 fixed discharge designs available for mounting heights to 50 ft, floor coverage to 132 ft square, according to manufacturer—*L. J. Wing Mfg. Co., 140 Vreeland Mills Rd., Linden, N.J.*



Radiant Electric Heater . . .

. . . for baseboard installation consists of modular plug-in units—2 ft standard length, control section, and corner section; provide 250 w per linear ft output with thermal overload switch; ends of each section are made of plastic—*Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.*



Air Compressors . . .

. . . in 15 and 20 hp models, feature single motor drive for two pumps, 120 gal tank and magnetic starters; displacement 76 or 96 cfm at 100 psi, 63 or 80 cfm at 200 psi—*Champion Pneumatic Machinery Co., Princeton, Ill.*

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

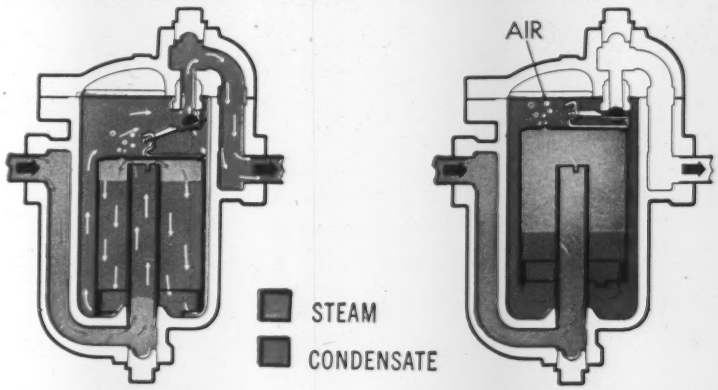
A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

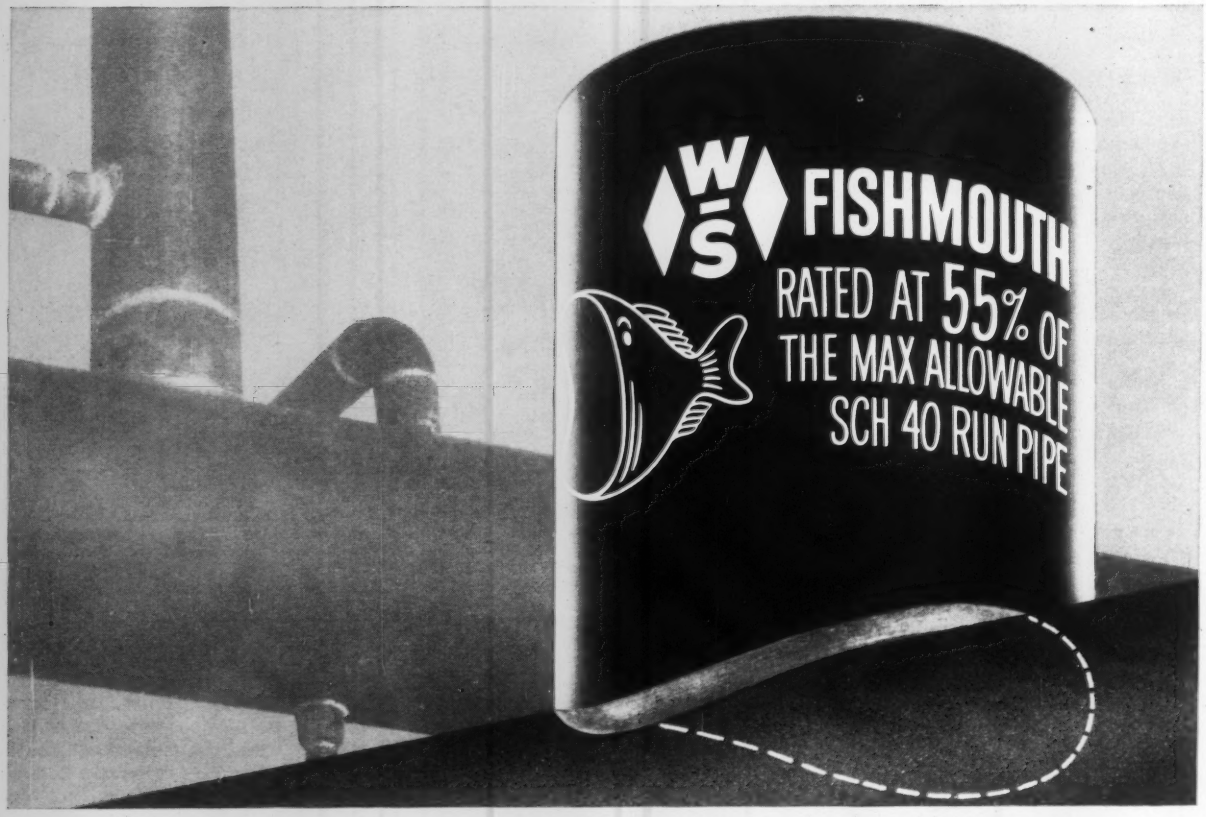
Armstrong Machine Works
8746 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For Branch Connections 2 inches or over:

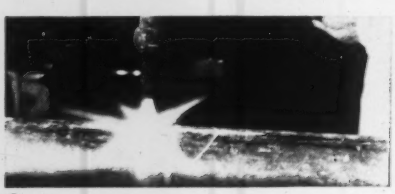
FISHMOUTH:

TRY THIS NEW WELDING FITTING; 2" SIZE COSTS ONLY 81¢ GIVES STRONG, LEAK-PROOF JOINTS!

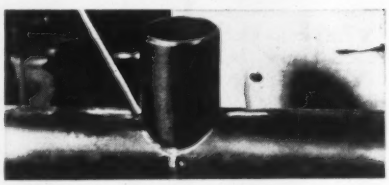


IT'S THE MOST PRACTICAL WAY TO MAKE A BRANCH CONNECTION

Mark



Cut



Weld

The W-S FISHMOUTH saves 50 percent or more over commercially available branch fittings. Made from Schedule 40 pipe, W-S FISHMOUTH is fully machined and perfectly shaped for strong, leak-proof joints. A ready-made W-S FISHMOUTH is rated for working pressures up to 55% of maximum run-pipe limits (for instance, it is rated at 350 PSI for 6″, Schedule 40 run pipe with a 660 PSI rating).

No time or cost required to shape, fit or bevel. Ideal for close-quarter work. Easy access to inspect weld penetration or to backweld. W-S factory machining means a secure, permanent installation every time.

Ready-made, the W-S FISHMOUTH costs less to buy and to install than anything on the market. Sizes: 2″ to 12″ IPS, butt weld ends. Fewer sizes handle many more jobs, eliminate need for special fittings. Write today for complete information, prices and names of distributors to: Forge & Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.

FORGE AND FITTINGS DIVISION PORTER ***H.K.PORTER COMPANY, INC.***

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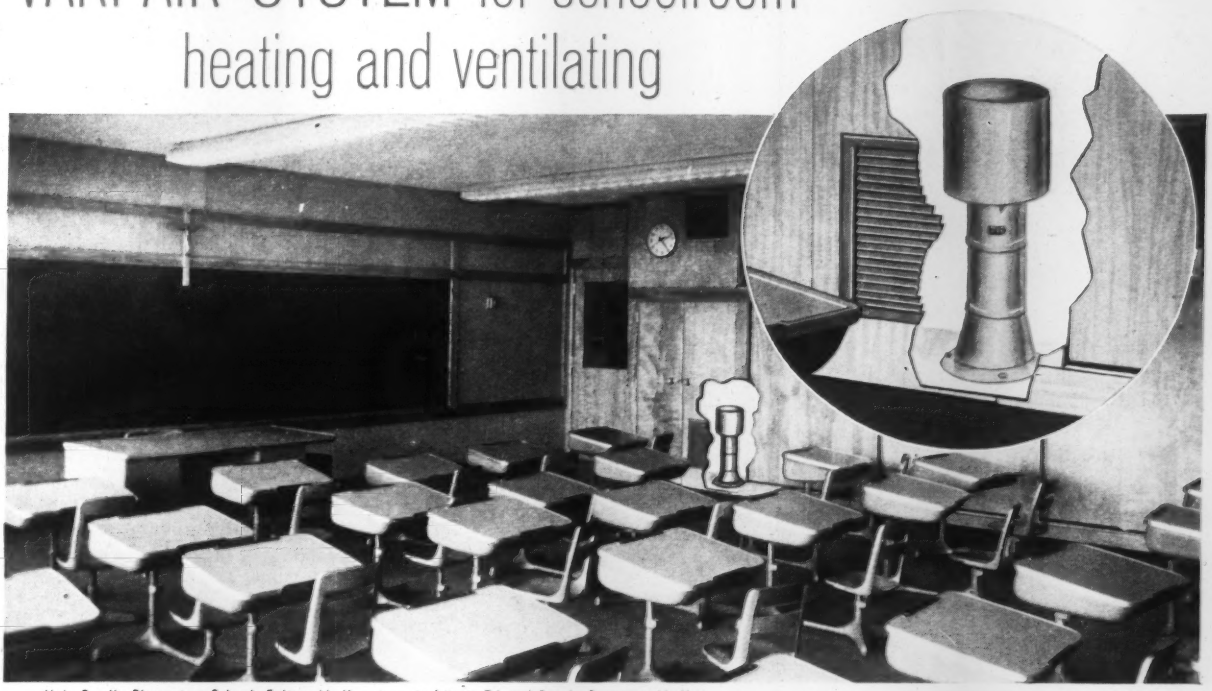
VARI-AIR SYSTEM for schoolroom heating and ventilating



Holy Family Elementary School, Fulton, N. Y.
Pastor: Rev. Edward C. Hearn
Architect: Edward Roock, Syracuse, N. Y.
Contractor: Kenneth A. Taylor, Inc., Syracuse, N. Y.

MECHANICAL INSTALLATION @ $1.36 per sq. ft.

Vari-Air, a "split system" which handles ventilation requirements by a separate Vari-Air unit in each room, combined with Vari-Vac automatic temperature control system, provide a dozen plus features for new schools such as Holy Family Elementary School in Fulton, N.Y.

Foremost is the achievement of satisfying a basic concern of school planners everywhere . . . cost, without elimination of any design requirements. Citing actual facts, not general claims:

1. At Holy Family Elementary School, heating and ventilating cost was $1.36 per sq. ft. compared to 23,520 sq. ft. gross building area cost of $11.59 per sq. ft. This $1.36 figure represents considerably lower installation expense and amounts to a sizable saving on the aggregate.

Other advantages, important to school planners, include:

2. More free floor area per room.

3. Quick morning heat-up.

4. Designed percentage of fresh air to recirculated air guaranteed regardless of outside temperature change.

5. Complete flexibility of individual room temperature.

6. Elimination of classroom overheating due to student heat gain or sun heat gain.

7. Complete automatic control of heat input to schoolrooms through variation of steam temperature and volume, to agree with outside temperature change demands.

8. No down drafts from cold windows.

9. No drafts from air circulation.

10. No mechanical noise or mechanical maintenance requirements in schoolrooms.

11. Lower decorating costs through slight pressurization of buildings.

12. No technical training of maintenance personnel necessary.

Vari-Vac and Vari-Air systems, manufactured by Dunham-Bush, illustrate the advantages of a single source and delegating a single manufacturer responsibility. For instance, Dunham-Bush products at Holy Family Elementary School include: Vari-Air units; Radiation; Duplex Vacuum Pump with Differential controllers; air handling unit; Vari-Vac temperature controls; Steam Specialties including float and thermostatic traps, strainers, oriflex valves, and orifice plates.

If you're planning a new school or modernization, write for full details on Vari-Air and Vari-Vac.

Only Dunham-Bush can give you the advantages of a Vari-Air system.

Dunham-Bush, Inc.

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AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

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heat-x HEAT-X, INC., BREWSTER, N.Y.
DUNHAM-BUSH DUNHAM-BUSH (CANADA), LTD., TORONTO, CANADA
DUNHAM-BUSH DUNHAM-BUSH, LTD., PORTSMOUTH, ENGLAND
BRUNNER BRUNNER CORPORATION (CANADA) LTD., PORT HOPE, ONTARIO

Yes, Dart Unions fit tighter and last longer because their two bronze seats are precision ground to a true ball joint. You get a drop-tight connection without straining arm, wrench or union. What's more, a Dart uncouples just as easily. Ask your supplier.

QUICK FACTS

- Extra wide bronze seats resist pitting and corrosion.
- Nut and body of air-refined, high test malleable iron are practically unbreakable
- Heavy shoulders can withstand the toughest wrench abuse
- Each Dart is individually vacuum-tested

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EQUIPMENT DEVELOPMENTS

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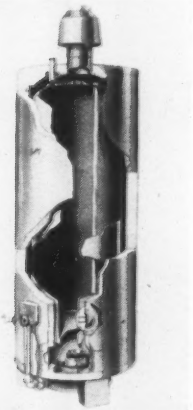
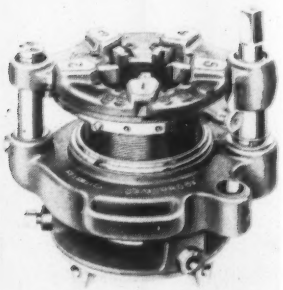


Industrial Water Heater . .

. . .glass-lined, 70 gal storage, with glass fiber insulation for use as general purpose hot water heater, booster heater, pre-heater, with forced or gravity circulation system—*Permaglas Div., A. O. Smith Corp., Kankakee, Ill.*

Round Duct . . .

. . .prefabricated of glass fiber in nominal sheet metal sizes; available in 6 ft sections, said to include acoustic and thermal insulation properties—*Gustin-Bacon Mfg. Co., 210 W. 10th St., Kansas City 6, Mo.*



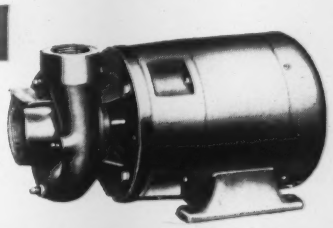
Pipe Threader . . .

. . .for 2½ to 4 in. pipe and conduit, operates over this range without changing dies; features cam action workholder with adjustable collar, threads straight or tapered; larger model accommodates 4 to 6 in. pipe. —*The Ridge Tool Co., Elyria, O.*

For AIR CONDITIONING— HEATING— or GENERAL WATER SERVICE

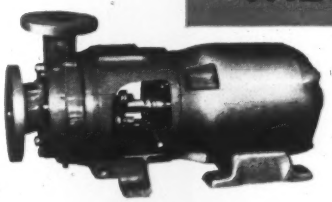
ONLY *Ingersoll-Rand can offer you such a complete line of pumps!*

THE "K" LINE OF MOTORPUMPS



These off-the-shelf Motorpumps are built in sizes from ⅓ through 25 horsepower to suit any condition to 775 gpm with heads to 190 ft. Advanced engineering and exacting manufacturing have produced these Motorpumps which handle liquids from −30°F to 211°F. Easily hooked up, they are ideal for air conditioning, heating or general water service. They are furnished in screwed connections from ¾" to 3".

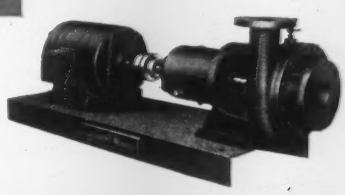
THE "RV" LINE OF MOTORPUMPS



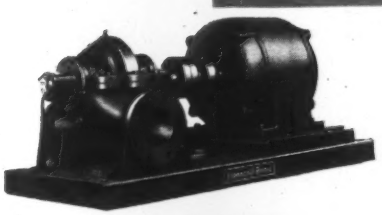
The class RV Motorpumps are made as single, two or four stage units available with screwed or flanged connections from 1" to 6". The extra-heavy construction with oversize shaft and bearings assure the maximum in dependability and performance. Built in 1 through 75 hp size these rugged units can deliver up to 3200 gpm . . . heads extend to 650 ft. This Motorpump line is well-suited for large air conditioning installations, heating (to 250°F), boiler feed or general water service.

THE CRADLE LINE OF PUMPS

Hydraulically and physically, the pump ends of these units are the same as those used on the close-coupled RV line of Motorpumps. For a given pressure, capacity and shaft speed, impellers and other parts are interchangeable. The cradle construction permits a variation of type of driver that can be removed or replaced without disturbing the pump intake or discharge piping. Sizes ¼ through 100 hp to handle liquids of temperatures to 400°F.



HORIZONTALLY SPLIT LINE OF PUMPS



Here's a really complete line of single or two stage, double-suction pumps for such service as cooling water circulation in condensers, cooling tower systems, air conditioning equipment, drinking water supply, heating, etc. Built in 1½ through 10 inch discharge sizes, deliveries range to 4000 gpm and heads extend to 1100 ft. Horsepowers range to 400 and liquids can be handled to 400°F.

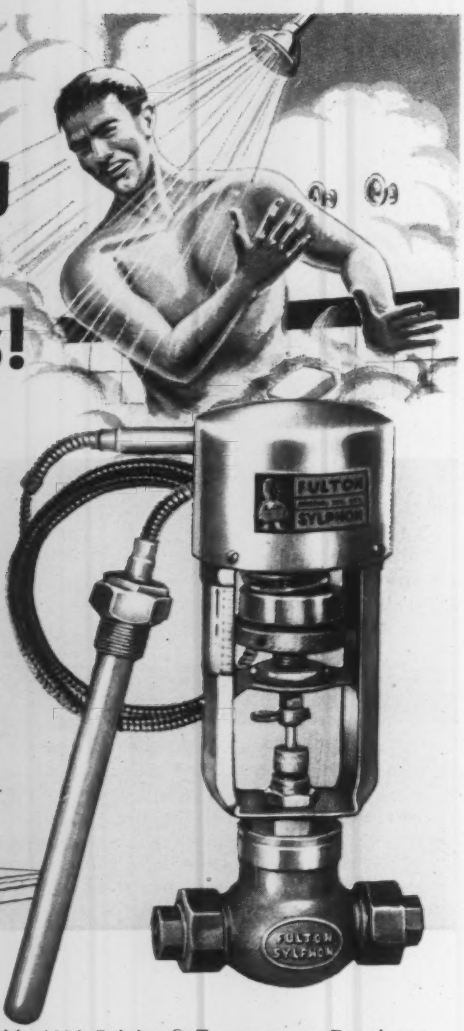
a century 1860 – 1960 *of pump progress*

from the leading manufacturer . . .

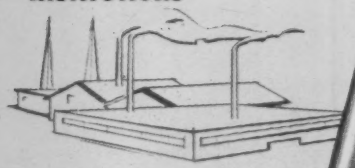
Ingersoll-Rand

79A9 11 Broadway, New York 4, N. Y.

No More "Scalding Water" Accidents!



Completely Safe Hot Water For Schools, Plants, Institutions



The fail-safe feature of this 1006 Sylphon® Temperature Regulator and the special "MA" valve combine to give double protection, prevent accidents, avoid injury claims, reduce lost time . . . by eliminating scalding water in showers, washrooms, or in processes using hot water or other liquids.

Under normal conditions, the MA valve closes dead tight to prevent leakage and temperature build-up during non-use hours; positive closure even with pressures up to 250 psig.

If corrosion, vibration or other accidents cause loss of the thermostatic charge, the built-in monitor moves the valve to a "safe" position and avoids overheating.

Higher sensitivity, greater power, longer life and trouble-free operation provided by large, two-ply seamless Sylphon Bellows. Fully self-powered; sizes ½" through 2"; (available with double-seated and 3-way valves up to 4"). Teflon® chevron lifetime valve stem packing ends leakage, gives smoother control, needs no lubrication.

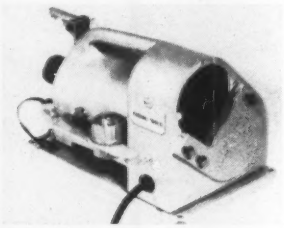
For complete information, write for Bulletin GH-D. **Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville, Tennessee.**

Robertshaw

MR CONTROLS

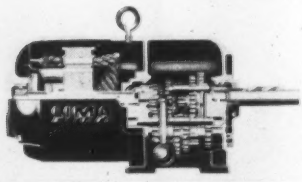
EQUIPMENT DEVELOPMENTS

Continued



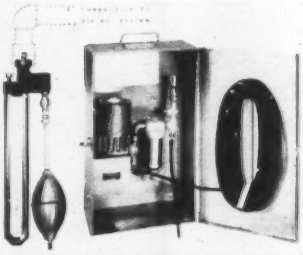
Tube Cleaner . . .

. . . for copper tubing and fittings, will clean and deburr sizes to 4 in.; portable, uses one rotary brush for outside, three sizes of brushes and deburring attachment for inside; 1/3 hp 115 v a-c motor, total weight 52 lb—*The Toledo Pipe Threading Machine Co., 1445 Summit St., Toledo 4, O.*



Selective Speed Drive . . .

. . . with 4 or 8 speed gearshift, 1 to 5 hp, 1800, 1200, or 900 rpm; may be mounted in horizontal or vertical position; gear ratio of 4.15:1 to 1.00:1 low to high, available with 2-speed motor, operates on 208, 220/440 or 550 v, 2 or 3 phase 60 cycle a-c—*The Lima Electric Motor Co., Inc., Dept. 519, Lima, O.*



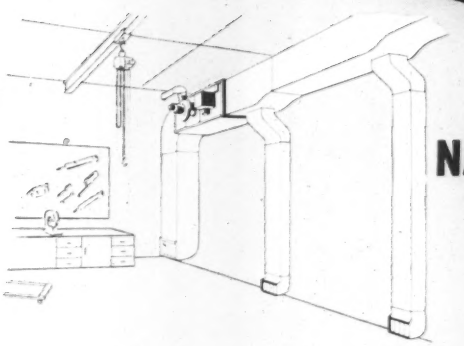
Leak Detector . . .

. . . consists of manometer with fittings plus rubber bulb or motor driven pump for pressure, with shutoff cock; manometer and pump may be purchased separately—*Eclipse Fuel Engineering Co., Combustion Div., 1100 Buchanan St., Rockford, Ill.*

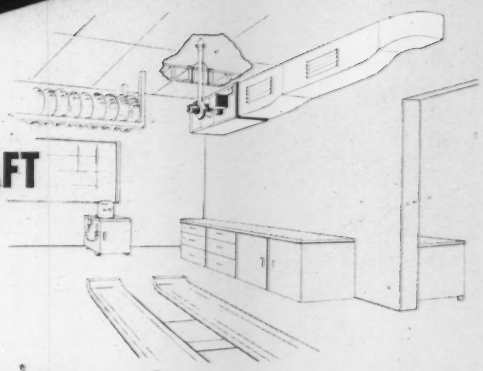
The new world of

HEATING

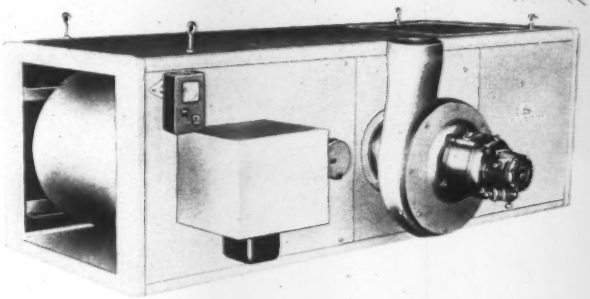
NO NATURAL DRAFT REQUIRED



IN GARAGE OR SMALL MANUFACTURING PLANT—DUCT OUTLET LOCATED AT FLOOR LEVEL



IN SERVICE STATION—VENT IS LOCATED THROUGH ROOF



Now...Iron Fireman CUSTOM Mark II oil fired furnaces

for commercial applications

The new combustion system used in this revolutionary furnace is entirely free from the difficulties resulting from erratic natural draft. It requires only an exhaust vent, which may be less than half the diameter of the usual smoke pipe. In a low roofed service station, for example, the furnace can be hung from the ceiling with only a few feet of vent pipe.

The convenient horizontal shape of this furnace, together with its built-in draft inducer that frees it from chimney problems, makes it especially useful in many commercial applications. Space that otherwise would be wasted, houses a complete heating plant. Can be used with or without warm air ducts in many buildings, including garages, service stations, stores, warehouses and small manufacturing plants. Units can be readily combined with air conditioning systems.

Smoke and soot are completely eliminated, resulting in remarkable savings in fuel and service costs. Sealed combustion chamber eliminates odors and reduces standby loss to practically nothing.

Mail coupon for complete information

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRCRAFT GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

Iron Fireman Mfg. Co., 3095 W. 106th St., Cleveland 11, Ohio
(In Canada, 80 Ward St., Toronto)

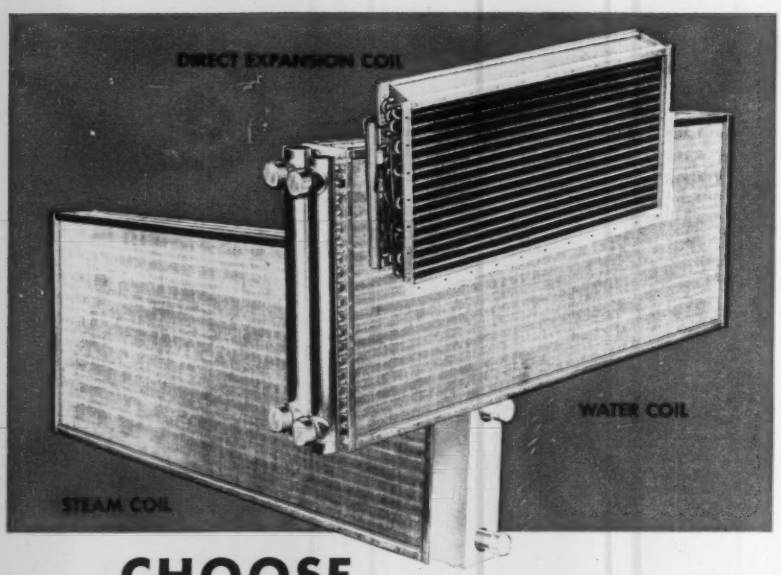
Please send information on the Iron Fireman CUSTOM Mark II horizontal furnace.

Name _____

Firm _____

Address _____

City _____ State or Prov. _____



CHOOSE BOHN KNOWN-CAPACITY COILS

ALL BOHN COILS are ruggedly built . . .

- Die-formed plate-type aluminum fins . . . from 4 to 14 per inch . . . with self-spacing collars completely covering the tubes. Permanent, tight, metal-to-metal fin-tube bond.
- Heavy-gauge casings die-formed from galvanized steel.
- Headers of heavy-wall seamless copper tube with heavy die-formed end caps. High pressure tested at 320 psig. minimum air pressure under warm water.
- Tested and rated according to ASRE-ASHAE standard 33-58.

IN ADDITION . . .

DIRECT EXPANSION COIL — Type DE, insures equal distribution of refrigerant with brass pressure-type distributors;

WATER COIL — in Types WH, WF, and WD, is drainable in every type;

STEAM COIL — in Types S, NFS, and NFO, has condensing tubes pitched in casing a minimum of ⅛" per foot of tube length, as well as orificed steam supply tubes, and coil tubes floating free within coil casing to prevent stress and strain on tubes and joints . . . maximum operating pressure 200 psig. at 400° F.

A Memo from BOHN:

We are one of the largest manufacturers of specially designed evaporators and condensers for Original Equipment Manufacturers of refrigeration and air conditioning units and systems.

For full information, call or write . . .

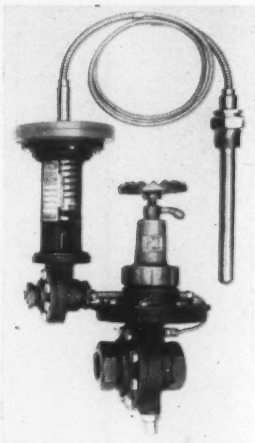
BOHN *Buy the known line . . . the BOHN line*

Aluminum & Brass Corporation

Danville Division • Danville, Illinois

EQUIPMENT DEVELOPMENTS

Continued

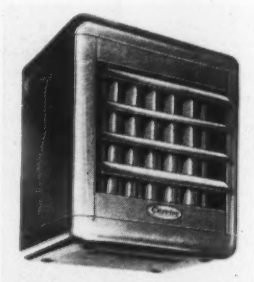


Combination Regulator . . .

. . . combines temperature-pressure regulating functions in one device, for pressures to 250 psi and temperatures to 500 F; in ½ to 2 in. sizes, ductile iron or bronze, with 10 temperature and two pressure ranges—*OPW-Jordan Corp.*, 6013 *Wiehe Rd.*, *Cincinnati* 13, *O.*

Metering Pump . . .

. . . for slurries and viscous liquids, in 4 sizes to 54 gph and pressures to 300 psi; features sealed flange joining of gear case and pump, self lubrication throughout, neoprene and nylon diaphragm, manual adjustment of discharge and piston stroke indicator—*The Madden Corp.*, 1345 *Jarvis St.*, *Chicago*, *Ill.*



Unit Heater . . .

. . . direct gas-fired, with two-stage thermostat for low and high speed output and fan operation; with 30,000 Btu per hr low speed and 50,000 Btu per hr high speed capacity—*Carrier Corp.*, *Carrier Parkway*, *Syracuse* 1, *N.Y.*

Quiet...

WAGNER Polyphase Resilient Mounted Motors in ratings through 10 horsepower

Quiet, vibration-free performance is essential when motors are installed in areas where noise must be held to a minimum . . . in hospitals, churches, schools, office buildings, restaurants and similar locations where quiet is needed or wanted.

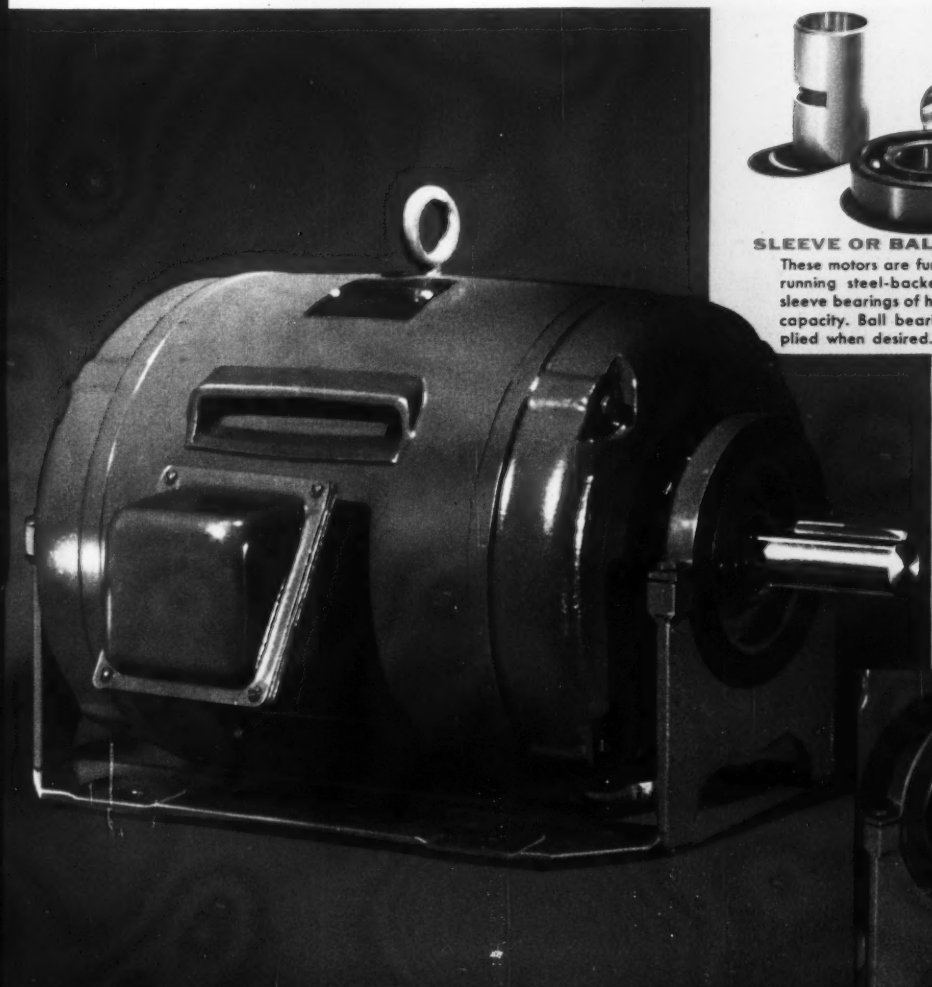
Such installations have created a need for larger polyphase motors that whisper while they work. Wagner has met this need by expanding its line of polyphase resilient mounted motors to include standard ratings through 10 hp.

You certainly have applications that call for a smooth running motor, cushioned by resilient mountings. To make sure they're quiet, specify Wagner Polyphase Resilient Mounted Motors. Only Wagner can provide an entire range of ratings through 10 hp.

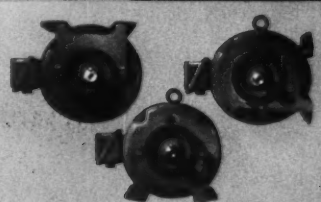
Constant research and development have kept Wagner up front in electric motor design for more than 65 years . . . made the name Wagner one you can depend on in choosing electric motor drives.

Your nearby Wagner Sales Engineer can help you select the right motor to meet your requirements. There are Wagner branch offices in 32 principal cities.

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

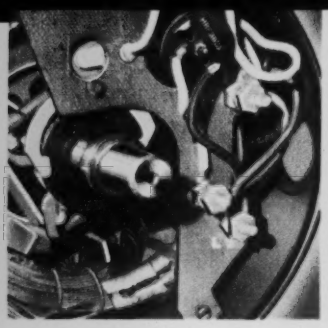


SLEEVE OR BALL BEARING.
These motors are furnished with quiet running steel-backed babbitt-lined sleeve bearings of high load carrying capacity. Ball bearings can be supplied when desired.

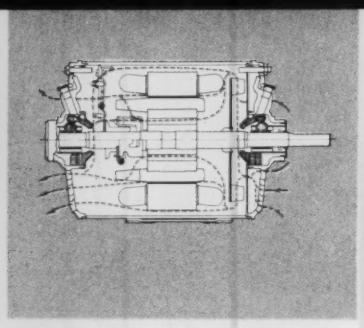


CEILING, SIDEWALL OR HORIZONTAL MOUNTING.
You can mount these motors on walls or ceilings by rotating the cradle base 90° or 180°. Motor stays dripproof.

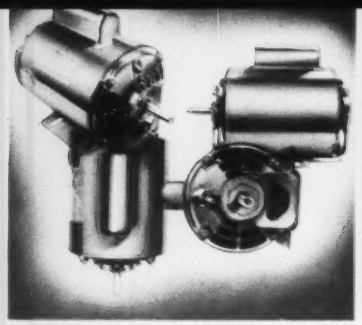
NEOPRENE CUSHIONING RING.
Annular mountings, of oil-resistant neoprene bonded to steel rings, cushion the motor in its cradle base to absorb the small amount of vibration that remains in the most carefully balanced motor.



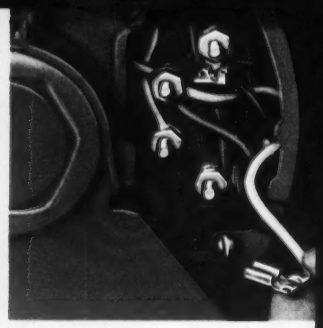
Quick Break Switch. The starting winding is disconnected from the line by this Wagner designed switch . . . test proved to make more than a million breaks. (That adds up to two starts per hour for 50 years!)



Efficient Cooling System. The improved ventilating system used in these motors directs a large volume of air through the motor to effectively reduce temperatures and add to motor life. Cross section indicates direction of air flow.



All-Angle Operation. The sleeve bearing design, in fractional hp ratings, has a positive lubrication system that permits operation in any position . . . can mean important savings in motor costs to manufacturers.



Quick Connect Terminals. Brass tabs on terminal studs permit quick, easy connection of leads . . . cut wiring time to speed assembly line production. Simply press the lead receptacle on to the stud—a positive connection is assured.

NO STARTING PROBLEMS with WAGNER CAPACITOR-START MOTORS

Pack more power into less space . . . give long troublefree service . . . are easy to hook up

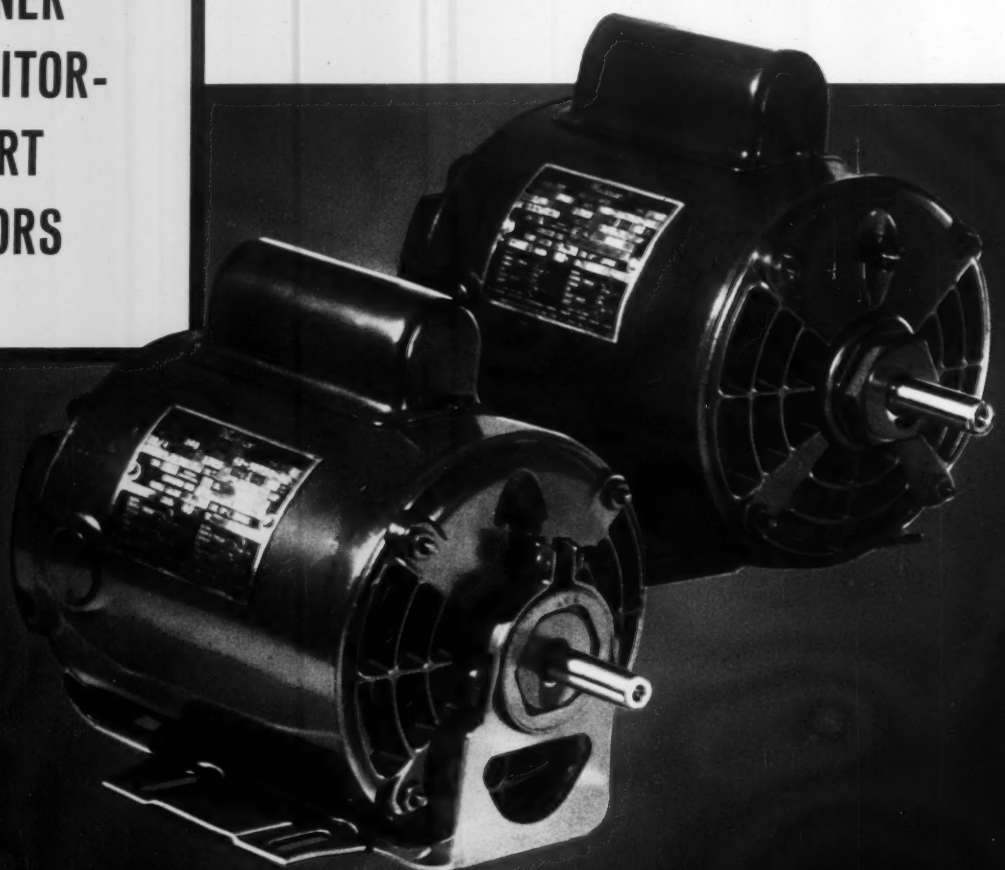
Here are general purpose single-phase motors that have high starting torque and high pull-in torque. When used in the proper application and supplied with voltage close to their rating, they'll give positive starts every time. Troublefree operation is assured . . . thanks to the positive action of the Wagner governor mechanism and long life quick-break switch.

Wagner Type RK Motors pack more power into less space. Small enough to fit in tight spots, their ruggedness is built-in . . . permits direct mounting. And, sleeve bearing fhp models can be operated in any position. They are available in a range from 1/6 through 5 horsepower, with sleeve or ball bearings, and with rigid bases or resilient mountings.

Get these motors from leading motor distributors in your city, or from Wagner sales offices in 32 cities across the country. Your Wagner Sales Engineer will be glad to help you select the right motor for your application. Wagner Bulletin MU-217 gives full details on Capacitor-Start Motors.

Wagner Electric Corporation
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

WM60-12



EQUIPMENT DEVELOPMENTS
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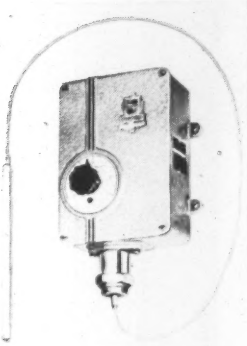
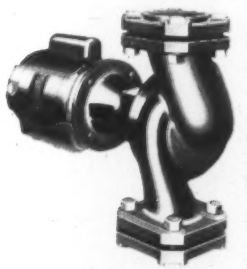


Temperature Control . . .
. . . non-indicating, for control of several stages of cooling or heating; equipped with two to five switches, may be set to perform up to five functions in sequence on rise or fall of temperature—*The Partlow Corp., 203 Campion Rd., New Hartford, N.Y.*



In-line Pump . . .
. . . for hot water heating and cooling systems, 3 in. outlet, with ½ or ¾ hp motor, 1 or 3 phase; pump bearings have double spiral groove for continuous lubrication; models develop maximum discharge pressure of 23 and 30 ft of water—*H. A. Thrush & Co., Peru, Ind.*

Arc Welder . . .
. . . with gasoline engine drive with manual or electric starting, provides 200 amp 30 v d-c welding output and 120 or 240 v a-c auxiliary power; features two welding cable plugs and duplex a-c receptacle, carrying-frame and optional wheeled dolly—*National Cylinder Gas Div., Chemetron Corp., 840 N. Michigan Ave., Chicago 11, Ill.*

WHERE CAN A COMPANY OBTAIN INFORMATION ON THE MOST MODERN METHODS OF CONTINUOUS DRYING?

One company recently placed orders for nearly $3,000,000 worth of Surface continuous dryers. More and more chemical and food plants are using the modern services of Surface Combustion engineers.

Purchasers are demanding dryers custom designed to fit the particular problem rather than "Hand-me-downs" to complete the plant automation.

Surface Combustion engineers have many advantages to offer: Kathabar Humidity Conditioning Units; Air heaters instead of individual burners; Laboratory Facilities for testing customers' products; large organization of engineers experienced in mechanical and structural design.

GET FACTS

Surface

59-4

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A division of Midland Ross Corporation
2384 Dorr Street, Toledo 1, Ohio
Send facts on Kathabar systems for following application:

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In Europe: NEDAIRCO, The Hague. In Japan: CHUGAIRO, Osaka.

Have You Tried a RIDGID® Hex Wrench Yet?

Six Sizes with Maximum Jaw Openings of 1 1/16", 1 1/2", 1 3/4", 2 1/2", 3 1/2" and 4 7/8" across flats.

the Perfect Mate for your RIDGID Pipe Wrench!

Finest of All Adjustable Smooth-Jaw Wrenches

MORE GRIPPING POWER... for all nuts. Puts a wrap-around grip on hexes that just won't slip. Because you're pulling with at least three flat sides at once, you'll never round off shoulders. Works on square nuts, valve packing nuts, unions and gas cocks and flat shapes, too. Smooth jaws won't even mar polished or plated surfaces.

RIDGID No. E-110 Offset Hex Wrench

Big Jaw, Short Handle for Sink and Tub Drain Nuts

Maximum Jaw Opening— 2 3/8" across flats.

RUGGED CONSTRUCTION... built good and solid. Thin but extra-strong jaws slip into tight places. The first time you use a hex wrench you'll know that here's a wrench you'll use for a long, long time. It's every bit as rugged as your familiar RIDGID Pipe Wrench.

RIDGID No. E-11 End Hex Wrench

Offset Jaw for Easy Work in Tight Places

Maximum Jaw Opening— 1 1/2" across flats.

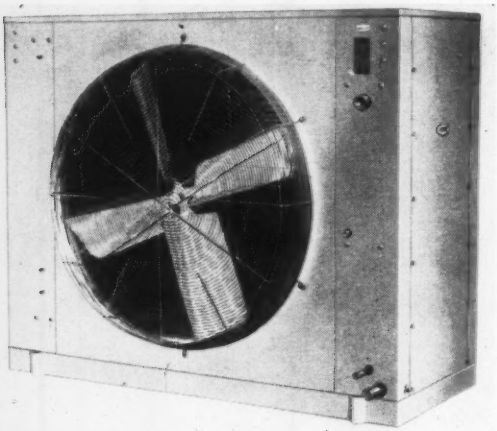
From experience you know it's easier to work with the best of tools. Order your RIDGID Hex Wrenches from your Supply House today!

RIDGID

The Ridge Tool Company • Elyria, Ohio, U.S.A.

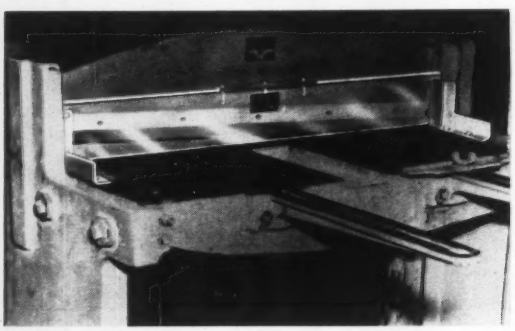
EQUIPMENT DEVELOPMENTS

Continued



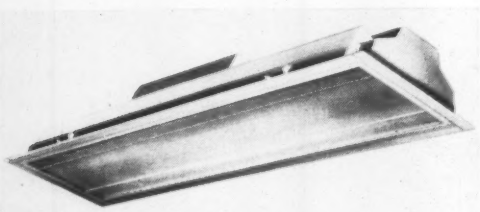
Air Cooled Condenser . . .

. . . with copper tube-aluminum fin coil, 4 ft propeller fan; new refrigerant circuit delivers liquid to evaporator coil up to 20 F cooler than condensing temperature, according to manufacturer; 17 ton capacity unit is 64 in. high, 80-3/8 in. wide, 50 in. thick—*Lennox Industries, Inc., Marshalltown, Ia.*



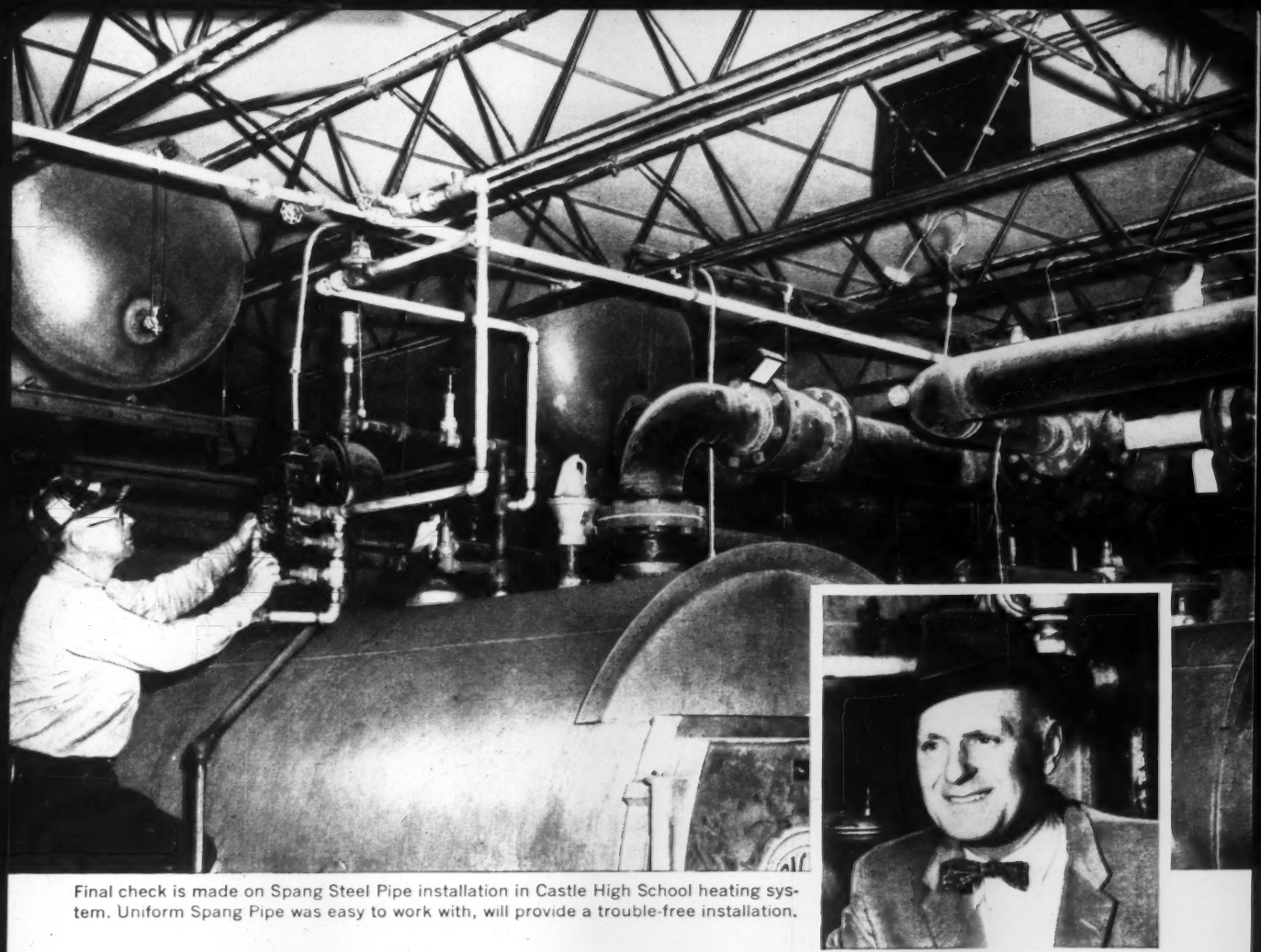
Blade Guard . . .

. . . for 30 and 36 in. metal squaring shears consists of clear plastic adjustable shield fastened to ends of shear frame; can be used on all metal thicknesses, mounts 3/8 in. above shear table—*Brett-Guard Corp., Englewood, N.J.*



Diffuser-Light . . .

. . . incorporating air diffuser slots along both sides of 1 by 4 ft or 2 by 4 ft 2, 3, or 4 tube fluorescent light; with 5 ft expanding cone damper—*Barber-Colman Co., 1300 Rock St., Rockford, Ill.*



Final check is made on Spang Steel Pipe installation in Castle High School heating system. Uniform Spang Pipe was easy to work with, will provide a trouble-free installation.

"SPANG® is tops...they don't make any better steel pipe than that!"

says Mr. Jack C. Gottman, Jack C. Gottman & Co., Evansville, Indiana

"We always use 'good' pipe in our installations, and usually it's Spang," reports Mr. Gottman. "That's why we used Spang Steel Pipe in the heating system at Castle High School, Paradise, Indiana.

"Spang Steel Pipe is uniformly straight and true. It has a good galvanized finish that doesn't chip or peel in bending, and it threads nicely. It makes a good appearance in exposed locations, too. We expect Spang will give good service at Castle High for the lifetime of the school."

Quality control makes Spang tops in performance, dependability

Close manufacturing control from skelp through inspection builds into Spang Steel Pipe all those qualities you want on any job: uniformity of diameter, wall thickness and threads; straightness, clean interior, good finish, easy workability—and most of all—durability for long service life.

See your local Spang Distributor for good service on your next order. Remember: make it steel pipe . . . make it Spang Steel Pipe . . . made in USA.

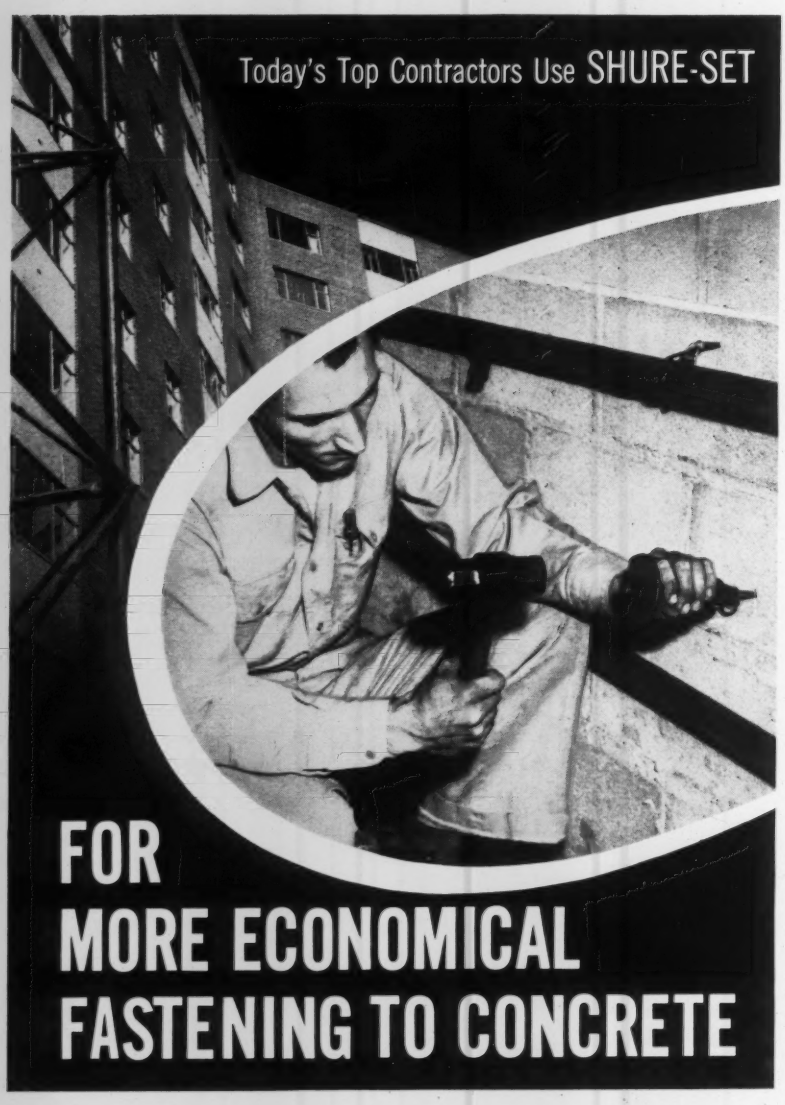
Architect: Lester W. Routt & Associates, Vincennes, Ind.
General Contractor: Peyronnin Construction Company, Evansville, Ind.
Mechanical Contractor: Jack C. Gottman & Co., Evansville, Ind.
Spang Distributor: Plumbing & Industrial Supply Co., Inc., Evansville, Ind.

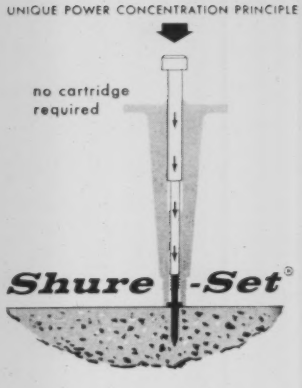
SPANG CW STEEL PIPE

THE NATIONAL SUPPLY COMPANY

Two Gateway Center, Pittsburgh 22, Pennsylvania

Subsidiary of Armco Steel Corporation





. . . another product by

When a job calls for light-duty fastening into concrete or block, Shure-Set is the ideal choice! This hammer-powered tool (no cartridge required) is designed to pinpoint hammer strokes on the head of special austempered fasteners, setting them permanently in hard materials up to 15 times faster than out-moded methods.

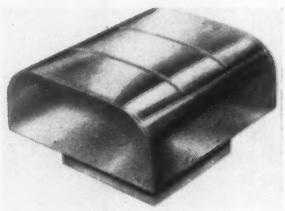
There's a Shure-Set fastener to meet every need of the plumbing and heating contractor who wants to save time and money while getting the most dependable fastenings on pipe hangers, duct straps, tie-downs, control boxes, thermostatic systems and a host of day-to-day applications. Write today for details, or call your Shure-Set dealer (under "Tools" in the Yellow Pages).

Ramset® Fastening System

OLIN MATHIESON — WINCHESTER-WESTERN DIVISION
291-D Winchester Ave. • New Haven 4, Conn.

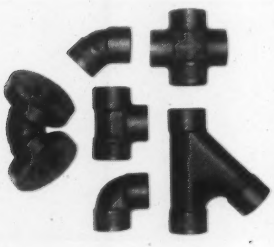
EQUIPMENT DEVELOPMENTS

Continued



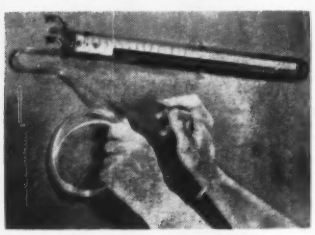
Exhaust Fan . . .

. . . for roof mounting, in fan sizes from 13 to 74 in., and exhaust capacities to 50,000 cfm; features vibration mountings, sealed bearings, steel or aluminum wheels, said to be 40 percent reduced in height—*Davidson Fan Co., 213 California St., Newton 58, Mass.*



Plastic Fittings . . .

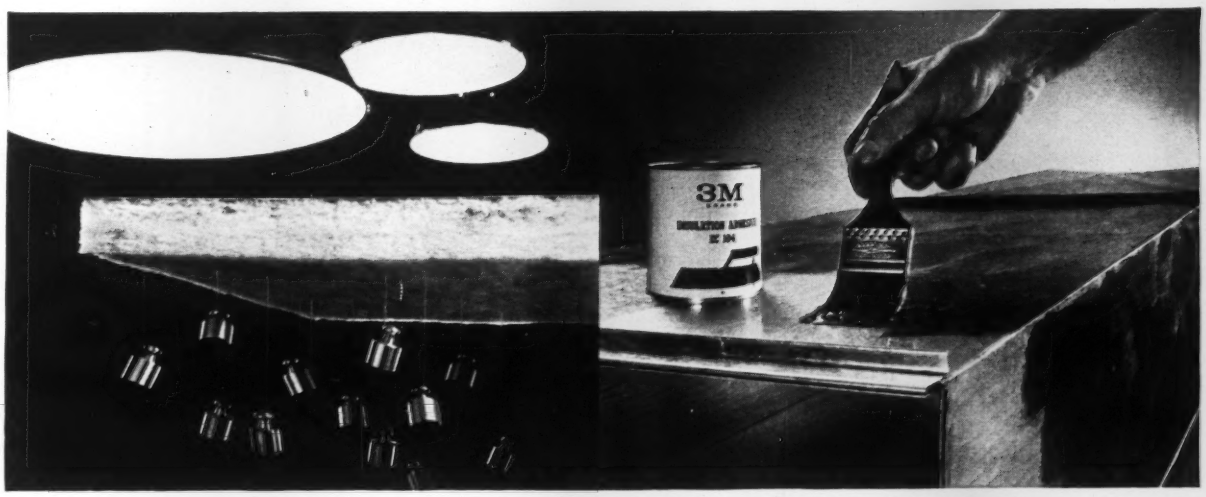
. . . glass fiber reinforced epoxy, in 1 through 6 in. sizes, 430 types; grades available for pressures to 1000 psi; said to offer excellent resistance to corrosively active liquids—*Ed Conley Plastic Corp., 91st & Delaware, Tulsa, Okla.*



Manometer . . .

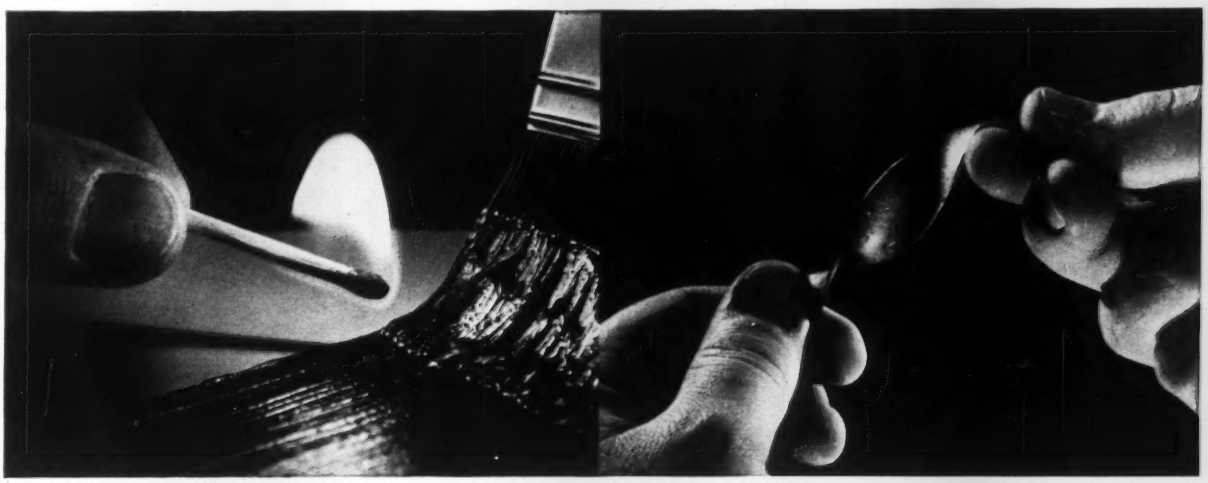
. . . for use in vertical or inclined position on low pressures; affords measurement of 0 to 16 in. water gage when used as U-tube, 0.20 to 2.60 in. WG when inclined, can be zeroed when inclined without use of spirit level; furnished with magnetic holding clips—*F. W. Dwyer Mfg. Co., Dept. HA-8, Box 373, Michigan City, Ind.*

There's a 3M Brand Adhesive or Sealer for every insulation need!



High heat resistance! Adhesive EC-1128 holds tight despite temperatures as high as 300°F; resists moisture so that steam can't loosen the bond. Even keeps its grip at —20°F. And EC-1128 provides both instant grip and long open time to let you do the job right! EC-1128 bonds foil-to-foil lapped seams, too.

Good coverage! Adhesive EC-104 provides unusually high coverage . . . quickly and easily . . . for greater economy. One pint covers up to 25 square feet when brushed on. If spray-applied, one pint covers 44 square feet. EC-104 gives you fast grip even when wet. And still . . . you get the convenience of long open time.



Nonflammability! Solvent-free Adhesive EC-321 won't burn during application—even near an open flame. You can apply insulation anywhere without fear of fire. EC-321 supplies a durable bond that resists high heat, moisture and vibration. It even bonds through thin oil films. Roll, brush or spray it on!

High velocity systems! Flexible Sealer EC-800 can be stretched twice its length before fracturing. It sets up firmly at duct joints, won't flow out of seams under pressure, yet it flexes with duct expansion and contraction. Actually adds structural strength to duct work. Apply with brush, flow gun or putty knife.

SEE WHAT 3M ADHESIVES CAN DO FOR YOU—Contact your 3M Field Engineer. Or, for more information and free literature telling how time-tested 3M Brand Insulation Adhesives and Sealers can help solve virtually all your insulation problems, write on your company letterhead to: A., C. & S. Division, 3M, Dept. SBI-40, 900 Bush Avenue, St. Paul 6, Minnesota.

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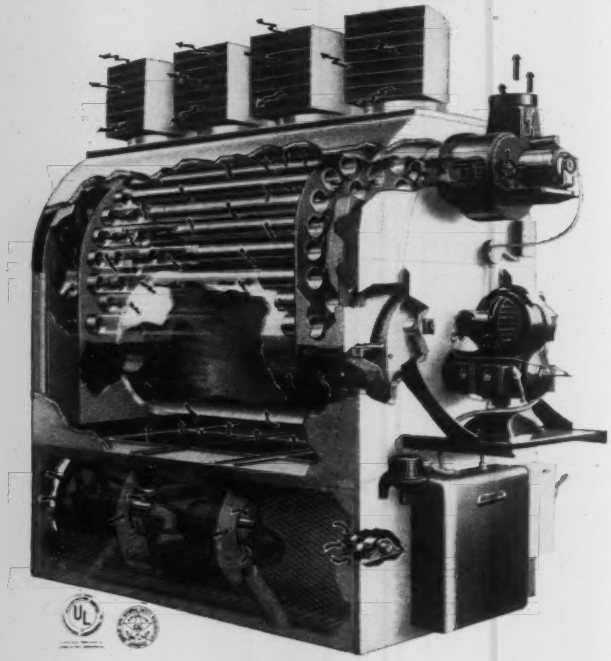

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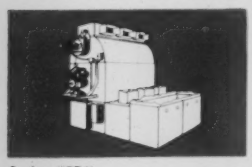
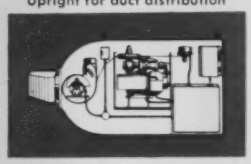
300,000 BTU's TO 2,000,000 BTU's

Provides industry with lowest cost heating. Primary cylindrical stainless steel combustion chamber, secondary heat-extracting tubes, consistent rate of combustion gas flow provides high efficiency, utilizing 80% of available heat of fuel. Highly adaptable to desired mounting arrangements. Features low first cost, easy maintenance, complete accessibility to all service points. Completely equipped and wired with controls for economical installation.

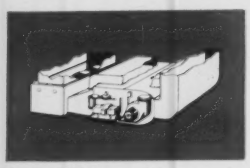


Series "FD"
Upright for duct distribution



Series "H"
Horizontally suspended.

Series "U"
Inverted suspended.



Series "HD"
Horizontally for duct distribution.

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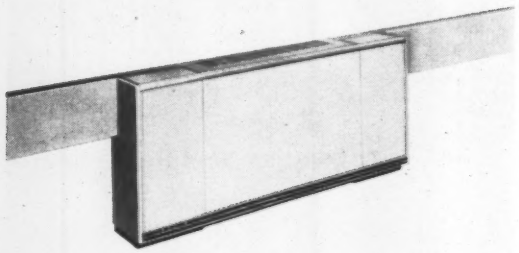
EQUIPMENT DEVELOPMENTS

Continued

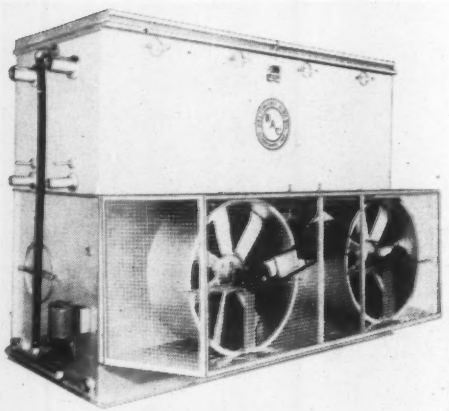


Schoolroom Ventilator . . .

. . . said to require 20 percent less floor space, available in five models for ventilation, steam, hot water, or electric heating, dual-coil mechanical cooling; in 28 or 32 in. heights, with top discharge or lateral extensions for below-window air curtain—*The Trane Co., LaCrosse, Wis.*

Metalworking Machine . . .

. . . with edge cutting capacity to 15/64 in. mild steel, throat capacity of 43 in., with tooling line available for straight, circle, and figure cutting, beading, folding, slot cutting, nibbling, planishing and flanging; brochure available on request; of Swedish manufacture, distributed through—*Homestrand Machine Tool Corp., 392 W. Putnam Ave., Greenwich, Conn.*

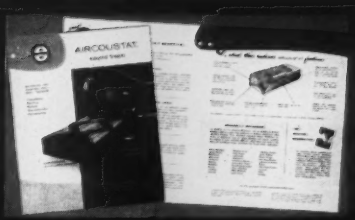


Evaporator Condenser . . .

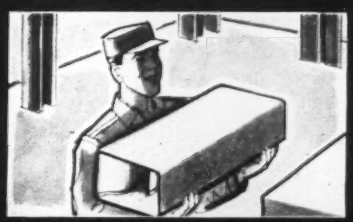
. . . in single factory assembled package in three models to 700 ton capacity, features hot dip galvanized construction, centrifugal or axial flow fans, aluminized finish on all surfaces; units to 100 tons available from stock, larger sizes on regular production cycle—*Baltimore Aircoil Co., Inc., P.O. Box 7322, Baltimore 27, Md.*

7 ways AIRCOUSTAT®
can save you time and money

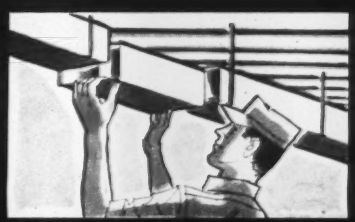
Sound Traps . . . with Guaranteed Results



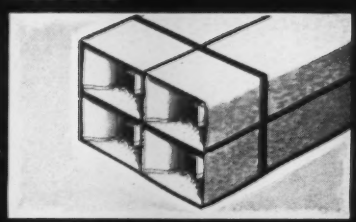
1) Easy to select—Just 3 steps to specify proper model. Save time, avoid errors.



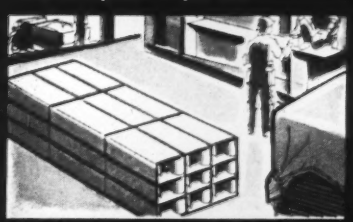
2) Easy to handle—No riggers or special equipment needed. Large units composed at job site.



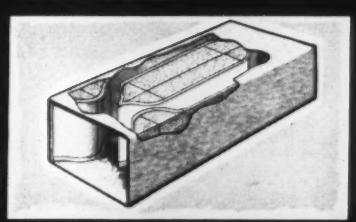
3) Easy to install—Units are installed the same as ductwork. Units have 2" extensions.



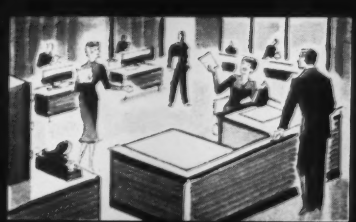
4) Fits all duct sizes—Big units are easily assembled from small Aircoustat units.



5) No storage problem—Units are delivered right to the job site, ready to install.



6) No maintenance—Units are fire-resistant, dust-proof and built to last a lifetime.



7) Guaranteed results—Solves every noise reduction problem. Units are completely reliable.

Pre-engineered by Koppers to eliminate guesswork, unnecessary calculations and difficult installations, AIRCOUSTAT Sound Traps guarantee trouble-free silencing of all duct-transmitted noise . . . at a savings in time and money to you.

AIRCOUSTAT selection is quick, simple and reliable. A choice of over 60 stock models, fabricated in 6 lengths, solves every noise reduction problem. AIRCOUSTAT is built to give a lifetime of maintenance-free service.

Write today for your copy of the AIRCOUSTAT Selection Manual, a quick guide to the right unit or combination of AIRCOUSTAT units to eliminate duct-transmitted noise in all air handling systems. Write KOPPERS COMPANY, INC., Sound Control Department, 3304 Scott Street, Baltimore 3, Maryland.

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METAL PRODUCTS DIVISION

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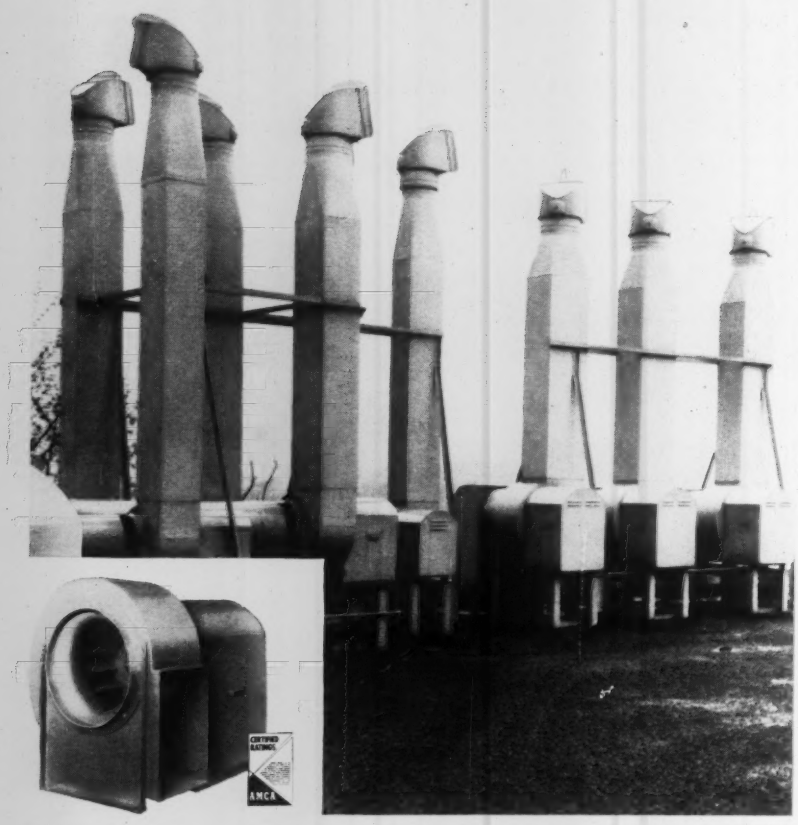

Peerless Electric Blowers Remove Fumes At Gulf Research Center

Shown here are Peerless Electric Backward Curve Blowers applied to exhausting flammable and harmful vapors from the cleaning room of Gulf's Automotive Products Evaluation Laboratory. These heavy duty blowers have arc-welded wheels with cast iron hubs and non-slip taper lock bushings.

Peerless Electric can engineer a blower for *every* important air moving job. Units, similar to this, are available for continuous supply and exhaust duty in air conditioning systems of schools, hospitals, public buildings and industrial installations.

On your next job, let Peerless Electric engineer your air moving needs. Write to: *Peerless Electric Division, H. K. Porter Company, Inc., W. Market Street, Warren, Ohio.*

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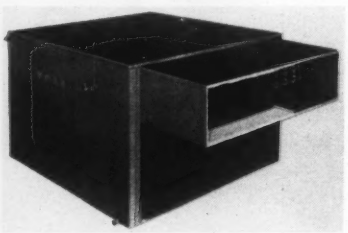
EQUIPMENT DEVELOPMENTS

Continued

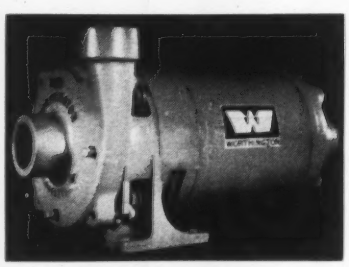
Flexible Hose . . .

. . . for steam transmission, in ¼ to 1 in. standard hose sizes, with plastic inner core, bronze wire reinforcing braid, brass fittings; available as assembled lengths or in special lengths with separate fittings for on-site installation—*Titeflex Inc., Hendee St., Springfield 1, Mass.*



Heat Pump . . .

. . . in 2, 3, and 4 ton sizes plus 5 and 7½ ton remote units feature "twin cooling systems," supplementary built-in electric heaters, automatic electric defrosting; designed to operate in atmospheric temperatures from 0 to 115 F—*York Div., Borg-Warner Corp., York, Pa.*



Centrifugal Pump . . .

. . . available in 6 sizes, fractional hp, for up to 80 gpm discharge, head to 110 ft water; with aluminum bronze cast impeller, mechanical seal said to be easily replaceable—*Worthington Corp., Harrison, N.J.*

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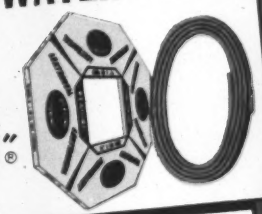

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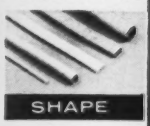

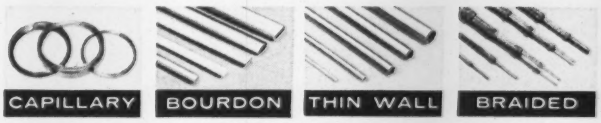

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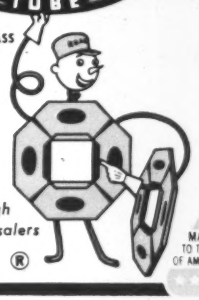

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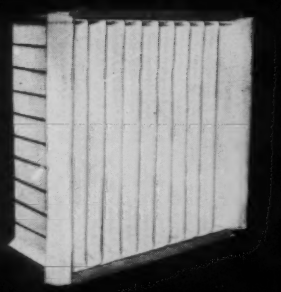

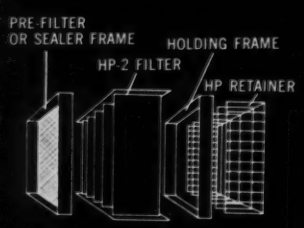

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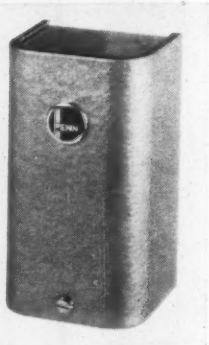
EQUIPMENT DEVELOPMENTS

Continued



Changeover Control . . .

. . . for use with combination heating and cooling thermostats operates on coil water temperature; control range is 60 to 90 F with approx 10 F fixed differential on 10 amp 120 v a-c electrical supply—*Penn Controls, Inc., Goshen, Ind.*

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. . . for heating, cooling, in 270, 470, and 600 cfm capacity models; designed for horizontal concealed installation, features drain pan designed to prevent damage to false ceilings and high capacity output—*Warren Webster & Co., Inc., Camden, N.J.*

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. . . portable, battery-operated for field or plant use; choice of batteries gives 13 to 17 liters per min sampling for 1 to 3 hours before recharging; equipped with filter holders, flowmeter, air pump and transistorized charger, total weight with shoulder bag 14 lb—*Gelman Instrument Co., 106 N. Main St., Chelsea, Mich.*

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  Costly shutdowns are eliminated. Packing is seldom necessary but may be added *under full line pressure*. No vents are necessary. Never needs repacking.
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  Durable chromium plated seamless steel sleeves. No chance *of metal fatigue*. Wrought steel bases provide rugged, positive anchorage.
- **INTERNAL AND EXTERNAL GUIDES**
  Positive alignment of sleeve in stuffing box *—where it counts!*
- **LIGHT WEIGHT, STREAMLINED DESIGN**
  Requires less space to install—less space to maintain—smaller manholes.

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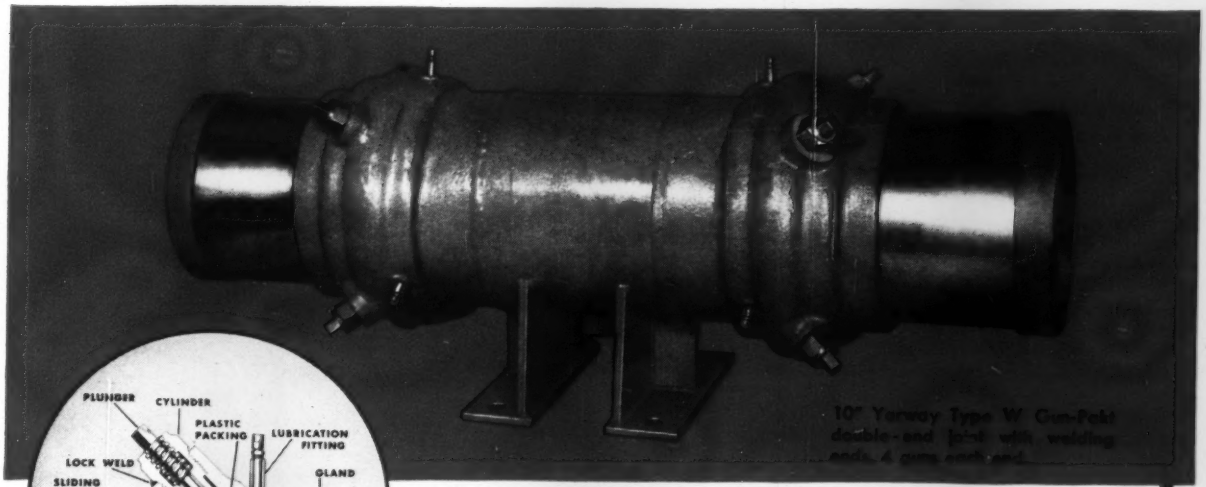
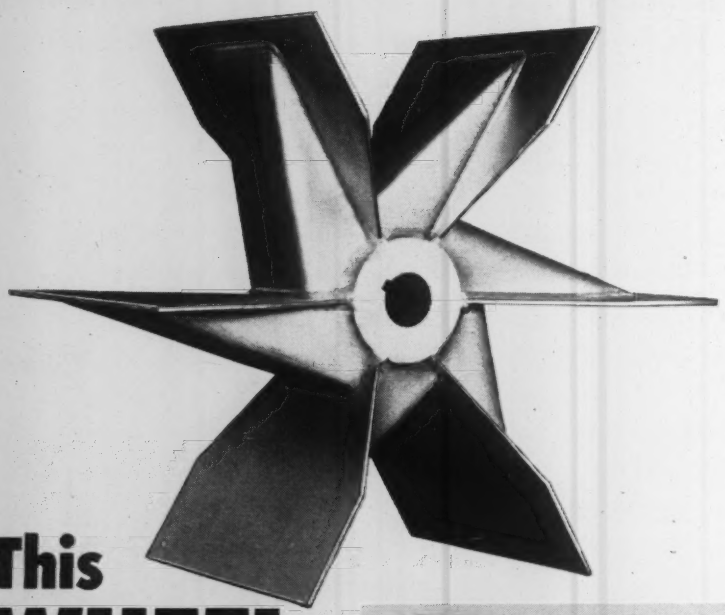
107 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



Cross-section of Gun-Pakt feature. To add packing, just insert a plug and turn the plunger. Note non-return packing slots.

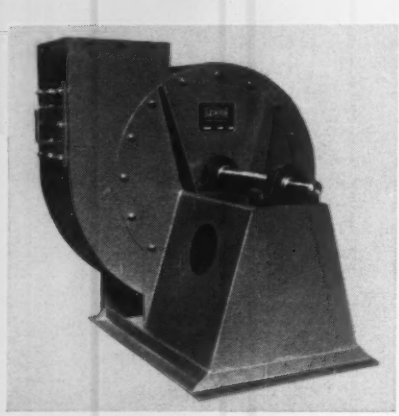
YARWAY GUN-PAKT



This WHEEL

MAKES LEHIGH I. E. INDUSTRIAL FANS IDEAL FOR TOUGH INDUSTRIAL EXHAUST APPLICATIONS

Handles dust-laden air and gases, paper shavings and the like without clogging



Lehigh Industrial I.E. Fans . . . featuring heavy duty, unique channel construction, all-welded mild steel wheels of the long shaving design . . . solve difficult exhaust problems because of their non-clogging characteristics. They incorporate a universal housing, which permits rotation and discharge to be modified to facilitate variable field conditions.

A complete range of sizes is available in both 70° to 250°F and 251° to 600°F construction. All standard drive arrangements are available and will be furnished according to your specifications.

Rugged, air-tight construction: the fan housing is welded on the inside with a continuous fillet weld. This provides gas-and air-tight housing with joints of maximum strength.

Standard, self-aligning ball-bearing pillow blocks . . . grease lubricated . . . are featured on all Lehigh Industrial I.E. Fans.

Optional accessories include an inspection door, inlet and outlet flange, heavy duty housing construction, and drain plug.

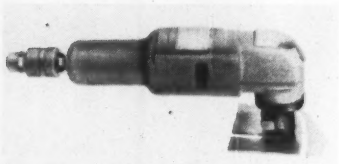
Get detailed information on how Lehigh I.E. Industrial Fans can solve your industrial exhaust problems with dependable non-clogging performance. Your Lehigh Representative will be happy to supply you with full details. Or, if you choose, write directly to us for Bulletin L-5:

2172
LF-2

LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA 1, Pa.
Subsidiary of General American Transportation Corporation

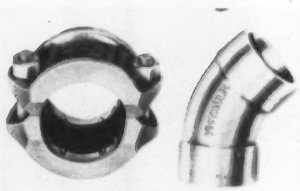
TRADE LEHIGH MARK

EQUIPMENT DEVELOPMENTS
Continued



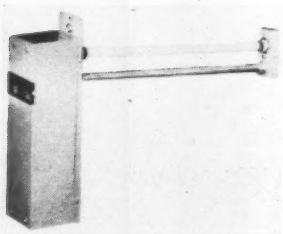
Pneumatic Nibbler . . .

. . . for cutting sheet metal up to 13 gage stainless steel without curling or distortion, according to manufacturer; features lightweight design, small size—*Modern Mfg. Co., Inc., 680 Davisville Rd., Willow Grove, Pa.*



Pipe Coupling . . .

. . . for plain or beveled end pipe; uses matched fitting and two-bolt coupling ring with stainless steel grips; requires no special tools, available in 1, 2, 2½, 3, 4, and 6 in. sizes; fittings with plain, threaded, or flanged ends for interconnection with existing piping—*Victaulic Co. of America, P.O. Box 509, Elizabeth, N.J.*

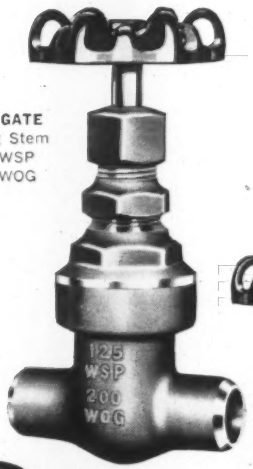


Deodorizer . . .

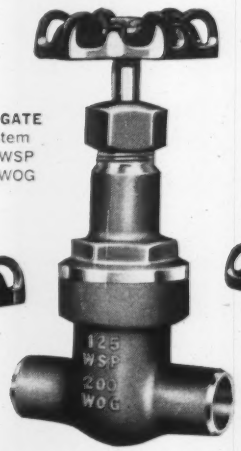
. . . utilizing ultraviolet lamps, suitable for commercial air conditioning systems when installed in main supply duct or plenum; has no moving parts, may be connected to blower starter switch or separate power source; 50 w tube rated at 7500 hr, according to manufacturer—*Atlantic Ultraviolet Co., 24-10 40th Ave., Long Island City, N.Y.*

pick your solder end valves from this line up of . . .

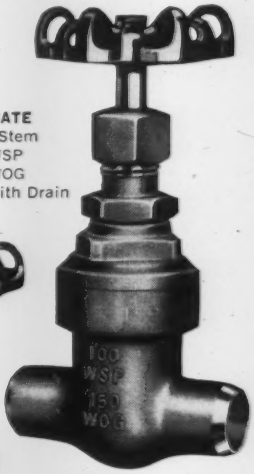
O-B VALVES



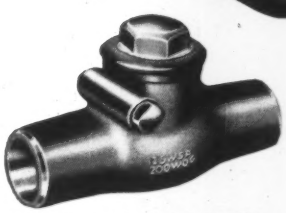
No. 2800 GATE
Non-Rising Stem
125 lbs. WSP
200 lbs. WOG



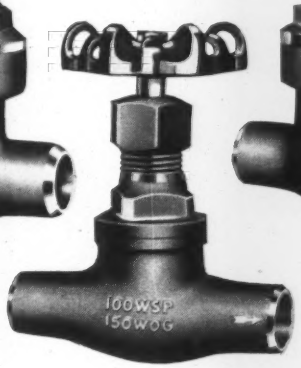
No. 2900 GATE
Rising Stem
125 lbs. WSP
200 lbs. WOG



No. 2400 GATE
Non-Rising Stem
100 lbs. WSP
150 lbs. WOG
Also available with Drain



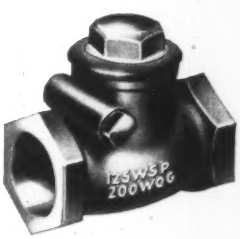
No. 1606 SWING CHECK
125 lbs. WSP
200 lbs. WOG
Brass, Composition or
Leather Discs



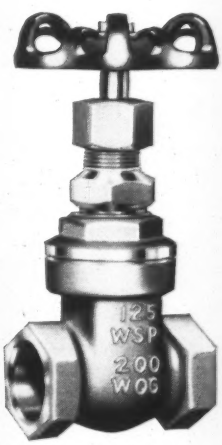
No. 601-X GLOBE
100 lbs. WSP
150 lbs. WOG
Soft Disc. Also available
in Angle or with Drain

No. 1601 GLOBE
125 lbs. WSP
200 lbs. WOG
Composition Disc. Also
available in Angle

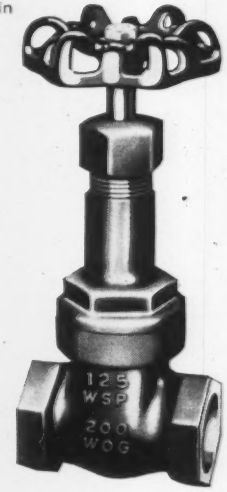
O-B VALVES with braze ends



No. 6606 SWING CHECK
125 lbs. WSP
200 lbs. WOG
Brass, Composition or
Leather Discs



No. 6500 GATE
Non-Rising Stem
125 lbs. WSP
200 lbs. WOG



No. 6700 GATE
Rising Stem
125 lbs. WSP
200 lbs. WOG

Here's why...

It takes only minimum torch time to bring valve ends to proper soldering temperature . . . even heat distribution results in better solder flow for a leaktight joint.

Ask your Ohio Brass Distributor about the complete line of O-B bronze valves. Or write to:

OHIO BRASS COMPANY
380 North Main Street
MANSFIELD, OHIO

4844-V

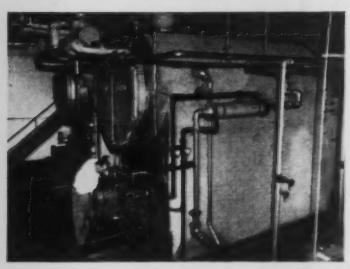
25-Year Exclusive User Again Selects Enterprise Burners

"Performance made choice easy,"

Says University Towers President

"There was never any doubt as to the make of oil burners we'd install in University Towers, our three new 15-story apartment buildings in Brooklyn," says Benjamin Neisloss, president. "Experience during the 25 years we've used them exclusively in our other apartment buildings proved Enterprises to be top performers – unusually economical, trouble-free and efficient."

This choice of additional Enterprise burners by a long-time user is typical of scores of such installations we make each year. Whatever your heavy duty commercial or industrial application, look to Enterprise for the finest in a complete range of oil and gas burners from 4 to 200 gph. Complete information and illustrated specification sheets available on request.



Abundant, dependable, economical heat for the 549 family units in the huge University Apartments, Brooklyn, N.Y., is supplied by 6 Pacific Loset boilers fired by 6 Enterprise J3-P fully automatic oil burners. Installation was made by Enterprise Engineering Co. Inc., Brooklyn, N.Y.

The Choice of Heating Experts

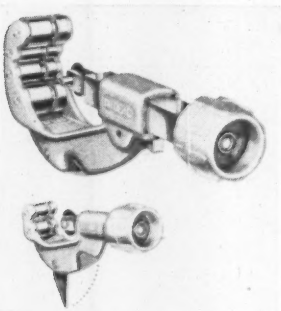
ENTERPRISE

DEPENDABLE BURNERS

ENTERPRISE ENGINE & MACHINERY CO. • 18TH AND FLORIDA STS., SAN FRANCISCO, CALIFORNIA

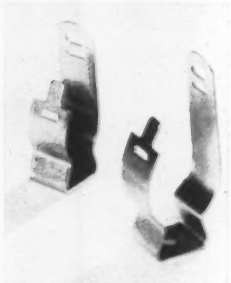
EQUIPMENT DEVELOPMENTS

Continued



Tubing Cutters . . .

. . . for 1/8 to 2 3/8 in. OD copper, brass, and aluminum tubing with optional wheel for plastic and aluminum pipe; feature enclosed feed screws, grooved rollers, spare cutter wheels; larger cutter has slide-to-size adjustment—*The Ridge Tool Co., Elyria, O.*



Buckle Clamp . . .

. . . for conduit attachment, in 1/2, 3/4, 1 and 1 1/4 in. sizes; features one piece construction and clamp-on installation—*The Paine Co., Westgate Rd., Addison, Ill.*

Time Meters . . .

. . . for recording cumulative operating hours of 120 to 480 v equipment up to 100,000 hr; 2 1/2 or 3 1/2 in. diam meters operate on a-c current, are sealed to withstand shocks and vibrations and against ambient dirt and moisture—*Hobbs Div., Stewart-Warner Corp., Springfield, Ill.*

Where ALLEN-BRADLEY Trouble Free Motor Control Is Especially Valuable!

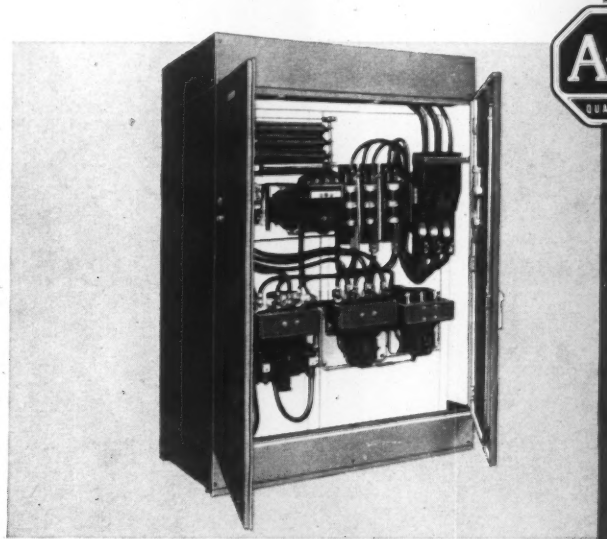
It's only natural to find Allen-Bradley—the *quality* motor control—being used with the large and important air conditioning jobs. The simple solenoid design—exclusive with Allen-Bradley in *all* starters up through Size 8—has only ONE moving part. With virtually nothing to go wrong, years of trouble free performance are assured. And the double break, silver alloy contacts—standard with all Allen-Bradley control—always remain in perfect operating condition. The permanently reliable "solder pot" overload relays are always on the job, irrespective of time or installation conditions, to protect against motor burnouts. Insist on Allen-Bradley—the motor control you can install and forget.

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Newly air-conditioned Roosevelt Hotel in Cedar Rapids, Iowa. Being somewhat distant from a metropolitan area, continuous operation—without "service calls"—is mighty important. Here, especially, trouble free control can prove its worth! The Allen-Bradley control panel, below, serves the complete air conditioning system for the hotel.

Consulting engineer: W. E. Nanes, Des Moines, Iowa.
Electrical contractor: Paulson Electric Company, Cedar Rapids, Iowa.

A-B QUALITY



View of compressor motor starter cabinet with doors open. A-B Bulletin 1238 star delta reduced voltage starter with closed circuit transition smoothly accelerates the motor.

Main Allen-Bradley control panel consists of cabinets for the 380-ton compressor motor starter alongside the Bulletin 798 control center housing A-B starters for auxiliary pump motors.

ALLEN-BRADLEY Member of NEMA — *Quality* **Motor Control**

Life in these excited states...

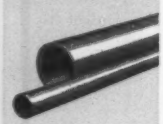
"This, gentlemen, is all that is left of Plant 'B' "

Survival . . . first rule for plastic pipe

Passive resistance . . . that's plastic's survival technique under the onslought of corrosive chemicals. Ace plastic pipe, for instance: inert, impervious, age-less . . . while metals and lesser materials dissolve and crumble. Best for the money anywhere . . . backed by 108 years' experience.

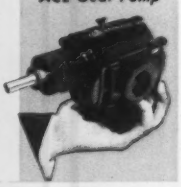
RIVICLOR *for ageless strength*

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*



NEW *ACE Gear Pump*

Improved design . . . now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*



SUPPLEX *tops in economy*

Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57.*

VALVE HEADQUARTERS

World's best chemical valves . . . at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ⅛" pet cocks to 24" gate valves.

ACE *chemical resistant equipment*

BY **AMERICAN** HARD RUBBER COMPANY

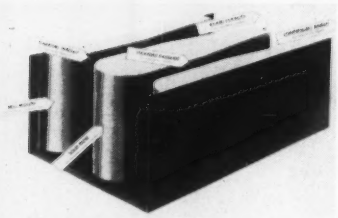
DIVISION OF **AMERACE** CORPORATION

ACE ROAD • BUTLER, N.J.

See ACE equipment in Chemical Engineering Catalog

EQUIPMENT DEVELOPMENTS

Continued

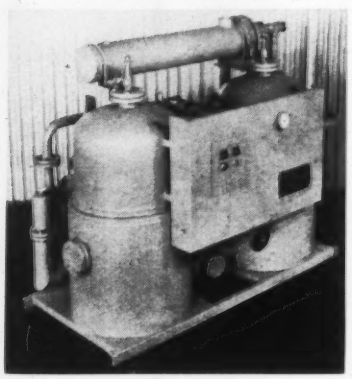


Duct Silencers . . .

. . . with "bell-mouth" entrance, combination narrow-straight throat, evase exhaust said to reduce turbulence; available in wide range of sizes and models to meet various air conditioning and ventilation requirements, according to manufacturer—*Industrial Acoustics Co., Inc., 341 Jackson Ave., New York 54, N.Y.*

Audiogage . . .

. . . for thickness testing of wide range of materials; two models provide accuracy of from 1 to 5 percent for thicknesses of from 0.06 to 12 in.; available with accessory transducers for tight locations, and magnetic probe clamp; bulletin "A-200" available on request—*Branson Instruments, Inc., 40 Brown House Road, Stamford, Conn.*



Gas Dryer . . .

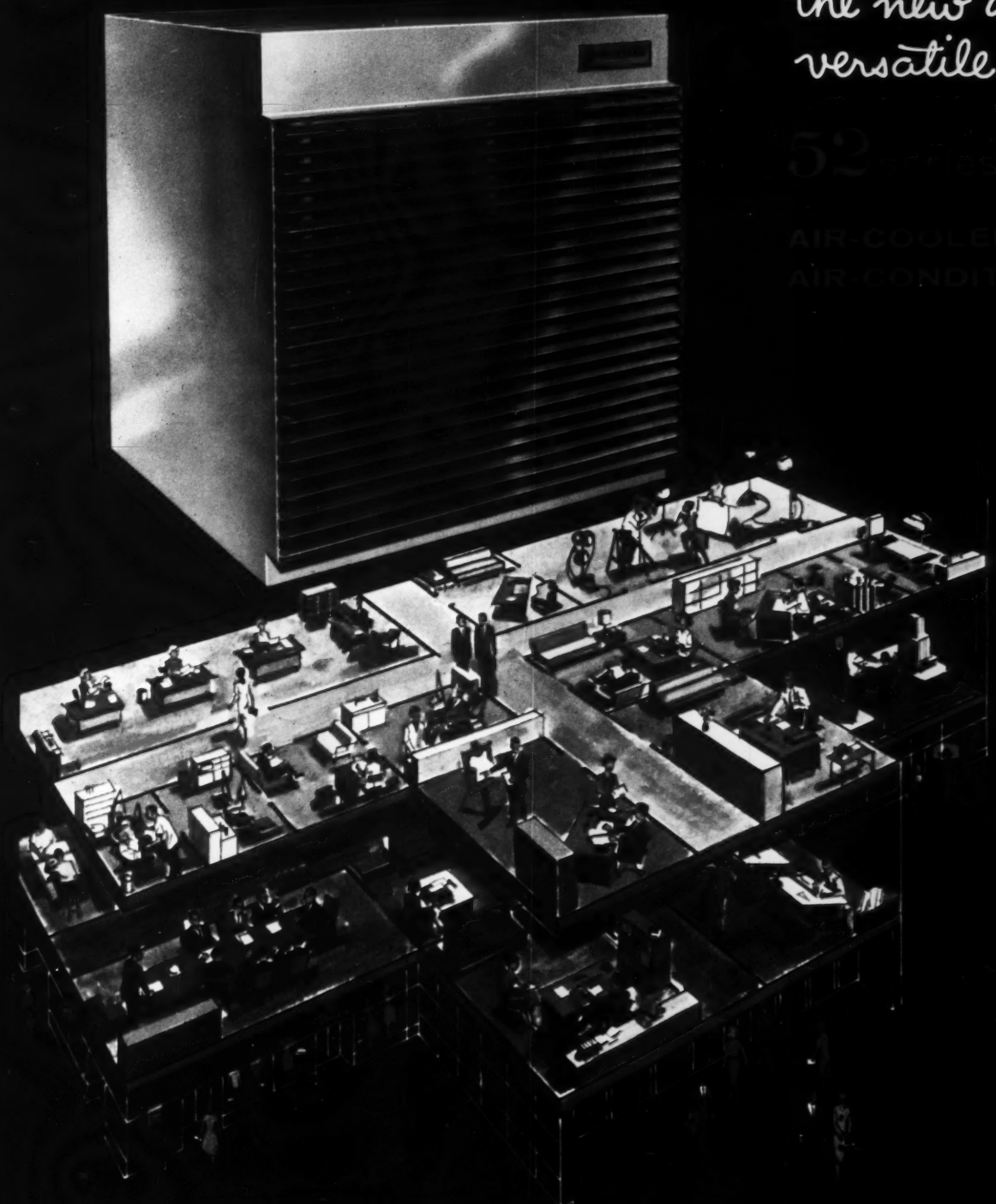
. . . for compressed air, other gases; adsorbs moisture; heats for regeneration, cools automatically; operates on six-hour cycle; features interchangeable parts, easy access for maintenance, according to manufacturer—*Pittsburgh Lectrodryer Div., McGraw-Edison Co., 32nd St., Pittsburgh 30, Pa.*

JANITROL

presents the new and versatile

52 SERIES

AIR-COOLED AIR-CONDITIONER

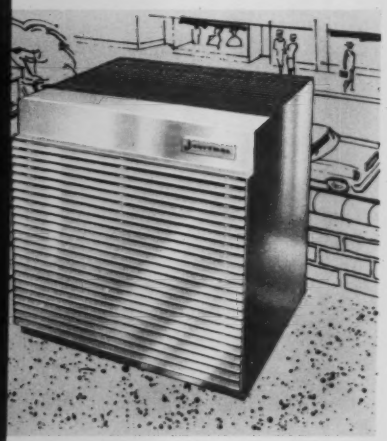


A PRACTICAL APPROACH TO ECONOMICAL, HIGH EFFICIENCY COOLING FOR COMMERCIAL—INDUSTRIAL BUILDINGS . . .

advance designed for the supplier

NEW JANITROL 52 SERIES AIR COOLED AIR CONDITIONERS

Outwardly beautiful and pleasing to the eye, inwardly rugged and powerful, new Janitrol 52 Series units combine years-ahead styling and cooling performance . . . provide truly low-cost central cooling with matchless reliability and performance.



JANITROL'S ADVANCED DESIGN . . . A SAFEGUARD AGAINST PRODUCT OBSOLESCENCE!

The weatherproof, high-efficiency 52 Series condensing unit, containing all moving refrigeration parts, installs outside. Available in six basic capacities from 22,200 to 110,200 btu/hr.

Full A.R.I. certification: Every Janitrol unit meets all standards of Air Conditioning and Refrigeration Institute.

STANDARDS OF EXCELLENCE . . .

In Performance—large condensing coils assure efficient operation with outdoor temperatures up to 125°F!

In Styling—crisp, modern lines distinguish the new 52 Series. Cabinets are finished in durable, automotive-type enamel.

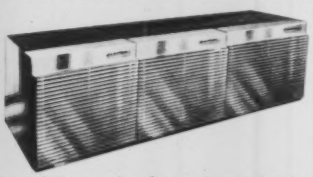
In Economy—The top-mounted fan bathes condensing coils in a jet stream of cooling air to raise efficiency and reduce current usage. Coils are shaded from the sun by louvers.

In Quietness—The powerful compressor is mounted on rubber-cushioned, resilient springs . . . cabinet is heated with special sound-deadening material.

In Safety—Complete overload and weather protection is provided. Enclosing grilles thoroughly safeguard children and pets.

In Servicing Ease—all components are easily accessible. Service panels can be removed without effecting operation during service checks.

MULTIPLE COMBINATIONS PROVIDE ECONOMICAL, HIGH CAPACITY COOLING

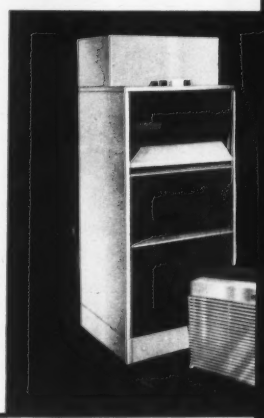


Modular cabinet design and upflow exhaust permit compact, multi-unit installations. Only the grilled, air-intake side of the cabinet requires clearance.

Any desired number of Janitrol 52 Series units may be installed together, with zero clearance between, to provide a variety of higher capacity combinations from 120,000 to over 1,000,000 btu/hr. Only Janitrol offers custom-built capacities at standard model cost!

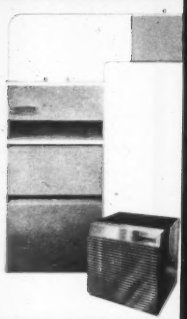
JANITROL year 'round conditioner

Combines quality gas heating and waterless cooling! Less than four sq. ft. of floor space needed for most installations. Features include famous Dura-Tube heat exchanger with 20-year warranty. Unique by-pass for correct air flow on heating or cooling cycle without adjustments. Powerful air-cooled 52 Series condensing unit. ADD-ON cooling—install for heating only, add cooling later.



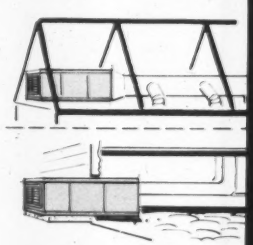
ADD-ON COOLING

Adapts most any warm air furnace for thrifty, efficient central cooling. Cooling coil mounts in duct, attractive, air-cooled 52 Series unit goes outside. Powerful, quiet performance with outside temperatures to 125°F. Easy to install.



"J-LINE" self-contained conditioners

An economical solution for many cooling needs. One compact unit contains blower, compressor and coils. For use with ducts or as free discharge. Install through wall in crawl space, attic or other limited access locations.

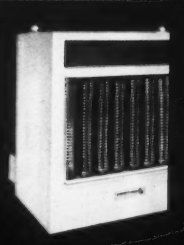


BLOWER-COIL UNITS

Smartly styled cabinet contains cooling coil and blower for use as free discharge or with ducts. Units are attached to ceiling to save floor space. Very quiet and efficient!

GAS-FIRED DUCT FURNACES

For installation in a duct where the air is circulated by a separate blower. Especially adaptable for industrial heating applications in combination with cooling. 73 Series in six sizes from 50,000 to 225,000 btu/hr. 72 Series in sizes 200,000 and 300,000 btu/hr. may be combined to provide unlimited capacity range.



JANITROL® HEATING AND AIR CONDITIONING

MFR

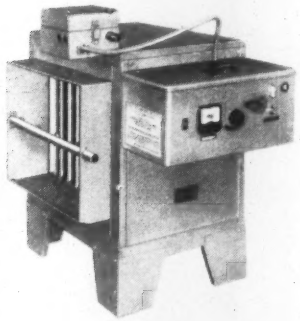
A DIVISION OF MIDLAND-ROSS CORP. • COLUMBUS 16, OHIO

IN CANADA: MOFFAT HEATING & AIR CONDITIONING DIVISION
MOFFATS LTD., TORONTO 15

ALSO MAKERS OF SURFACE INDUSTRIAL FURNACES, KATHABAR HUMIDITY CONDITIONING, JANITROL RESIDENTIAL HEATING AND COOLING EQUIPMENT

EQUIPMENT DEVELOPMENTS

Continued

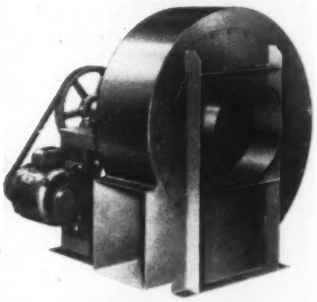


Electronic Air Cleaner . . .

. . . said to require less space, features 5/16 in. cell plate spacing; available in various models; units now available have horizontal or vertical air flow, in capacities from 800 to 10,000 cfm—*Electro-Air Cleaner Co., Inc., Dept. Z, Olivia & Sproul Sts., McKees Rocks, Pa.*

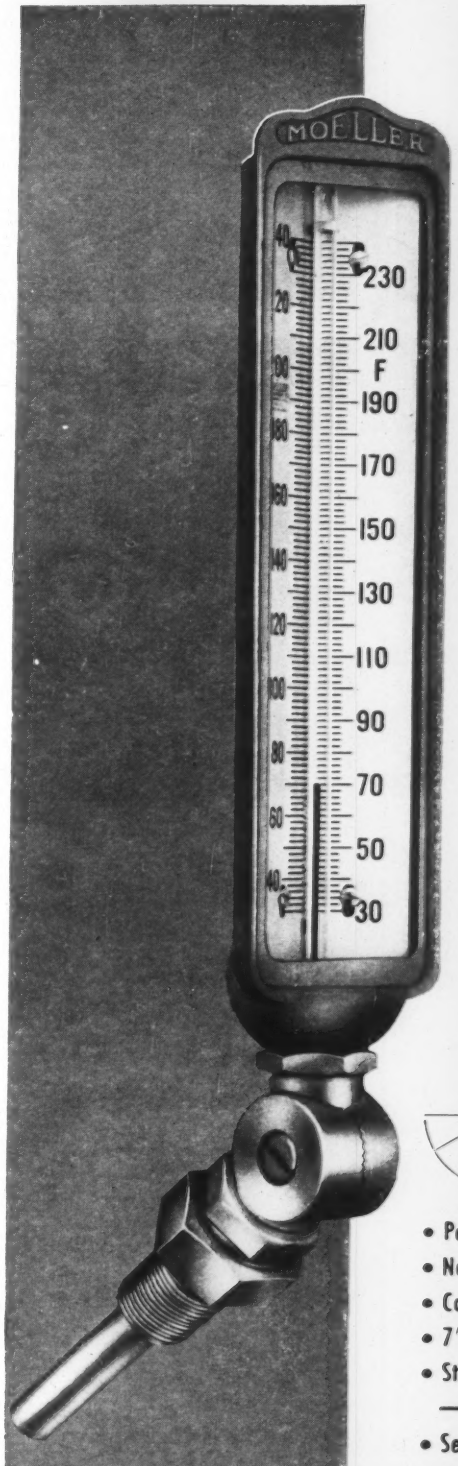
Welding Flux . . .

. . . for submerged arc single and double pass work at currents to 1200 amps; said to afford yield and tensile strengths of 59,000 and 71,000 psi, respectively, when used with mild steel welding wire; available in 80 lb bags or drums—*Hobart Brothers Co., Troy, O.*



Industrial Fan . . .

. . . in three wheel designs for gases, corrosive fumes, or material handling; in wheel sizes from 19⅛ to 64⅜ in., inlet sizes from 11 to 37 in.; feature welded housings or split housings for limited access installations, with optional seals, dampers, cooling wheels, access doors—*The Trane Co., LaCrosse, Wis.*



Presenting

THE

MOELLER

ADJUSTABLE ANGLE

INDUSTRIAL THERMOMETER

SAVES TIME

CUTS COSTS

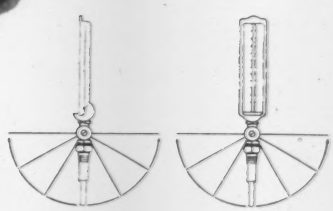
ADJUSTS TO

ANY ANGLE

for

ANY INSTALLATION

"Right-On-The-Job"



- Positive Locking
- No special tools
- Completely protected Capillary
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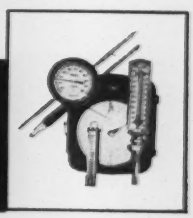
- Standard Ranges from —40° to +750°F.
- Send for Catalog No. 400



MOELLER INSTRUMENT COMPANY SINCE 1867

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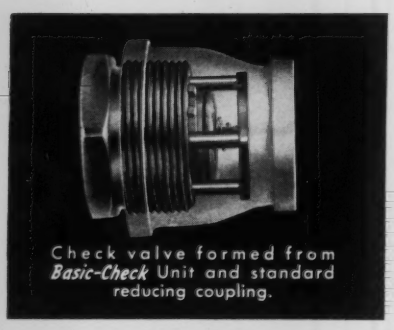
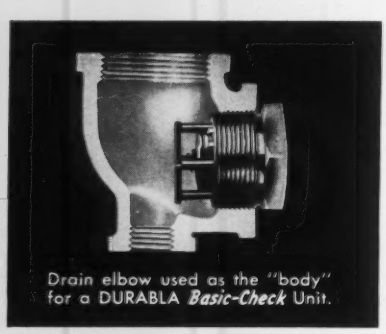
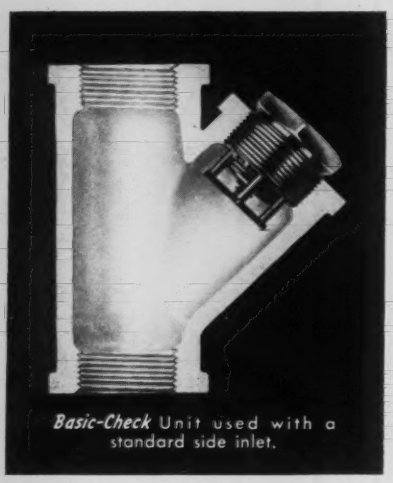


Check valve formed from *Basic-Check* Unit and standard reducing coupling.



Drain elbow used as the "body" for a DURABLA *Basic-Check* Unit.



Basic-Check Unit used with a standard side inlet.

Basic-Check Unit at inlet end of this bend completes the check valve.

How you can "make" a check valve to meet any emergency

Just take a DURABLA *Basic-Check* Unit . . . combine it with a standard pipe fitting . . . and you have a complete check valve that's perfect for practically any service. Keep a few *Basic-Check* Units on hand and you are prepared for any emergency.

Because it will operate in any position, the DURABLA *Basic-Check* Unit can be installed without changing existing lines. Made of stainless steel, they'll handle almost any liquid, gas or air . . . over a broad range of pressure-temperature ratings.

DURABLA *Basic-Check* Units are versatile, dependable, efficient and inexpensive. They come in seven standard line sizes, from ⅜" to 2". Also available: DURABLA Reducing Couplings of stainless steel.

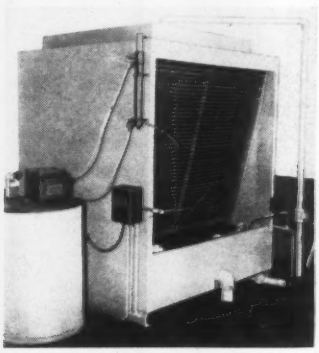
Ask for a copy of Bulletin HPA-40.

DURABLA MANUFACTURING COMPANY
114 Liberty Street, New York 6, New York

DURABLA®

DM-32

EQUIPMENT DEVELOPMENTS
Continued



Chemical Feeder . . .

. . . for recirculating water systems, with automatic adjustment of feed and bleed-off proportionate to water evaporation or cooling load; for acid or alkaline treatments; controller section available separately for combination with existing feeder installations —*Heller Laboratories, Inc., 124 Fort Lee Rd., Leonia, N.J.*

Diameter Measure . . .

. . . consists of graduated tape with vernier for inside or outside diameter measurement of round duct, sheet metal stock, etc., from 2 to 12 in.; reads directly from tape to 0.001 in. accuracy, according to manufacturer —*Pi Tape, P.O. Box 397, Lemon Grove, Calif.*

Indicating Transmitter . . .

. . . available with measuring elements for 0 to 10 in. water gage to 0 to 30,000 psi pressure, 150 to 1000 F temperature, for flow differential pressures from 0 to 1 up to 0 to 400 in. WG, and −50 to +165 F dew point; calibrated to ±½ percent accuracy, according to manufacturer—*The Foxboro Co., Foxboro, Mass.*

GOOD NEIGHBOR POLICY IN PLUMBING:

How the boiler room of the Hudson Bay High School also serves the school across the street

And a neighborly boiler room it is! From it, 100,000 feet of USS National Pipe, in the form of steam heat, plumbing, air and fuel lines, serves not only the Hudson Bay High School, Vancouver, Washington, but is used to pipe steam across the street to a vocational school, too. USS National Pipe in sizes from ½-inch through 12 inches was used.

Do you need quality pipe for power, heating and air conditioning installations? You'll get it when you ask for USS National Steel Pipe. If you'd like further information, or immediate assistance with your pipe problems, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS and National are registered trademarks

Plumbing & Heating Contractor: Longview Plumbing & Heating Company. Mechanical Design: J. Donald Kroeker & Associates, Consulting Engineers.

The world's largest and most experienced manufacturer of tubular products.

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

Engineered Features of Super-Silvertop Steam Traps Assure Trouble-Free Operation

For trouble-free steam trap operations, with engineered, maintenance reducing features, install Super-Silvertops. First, there are no narrow cored passages to become clogged or to limit the flow. Second, a patented center tube guide arrangement of the bucket assures positive seating—keeps all parts in proper alignment. Third, valves and seats are made of Anderloy, an alloy developed to resist corrosive action. And fourth, reverse flow feature keeps the bucket stationary even under heavy loads, cleans trap of sediment and dirt. Send coupon for Bulletin #26, giving sizing details of these remarkable trouble-free traps.

A TRAP FOR EVERY PURPOSE

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division of International Basic Economy Corporation
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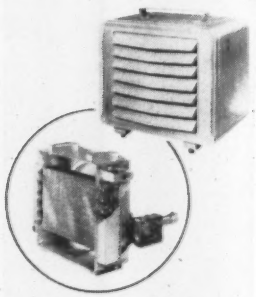
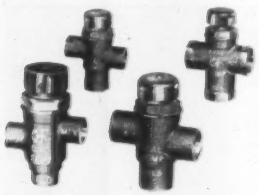
ANDERSON SUPER•SILVERTOPS

EQUIPMENT DEVELOPMENTS
Continued



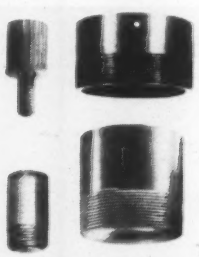
Unit Heater . . .

. . . electric, in 2 to 10 kw models, for portable or mounted use; axial-flow fan, thermal cut-out device, stainless steel fin heating element featured; with built-in or remote thermostatic control—*Markel Electric Products, Inc., Buffalo 3, N.Y.*



Mixing Valve . . .

. . . in ½ or ¾ in. sizes with threaded or sweat connections, for maintenance of hot water temperature in 110 to 130 F range; literature available on request—*General Fittings Co., East Greenwich, R.I.*



Threading Machine . . .

. . . for use on plastic and metal materials and inside or outside wall; pitch and root diameters are held to 0.001 in. tolerance, according to manufacturer; can be set up on 9 in. to 20 in. lathe for cutting ½ in. to 9 in. internal threads and 1/32 in. to 9 in. external threads of various types—*The Fen-Thread-Machine Co., Inc., 3107 N. Broad St., Philadelphia, Pa.*

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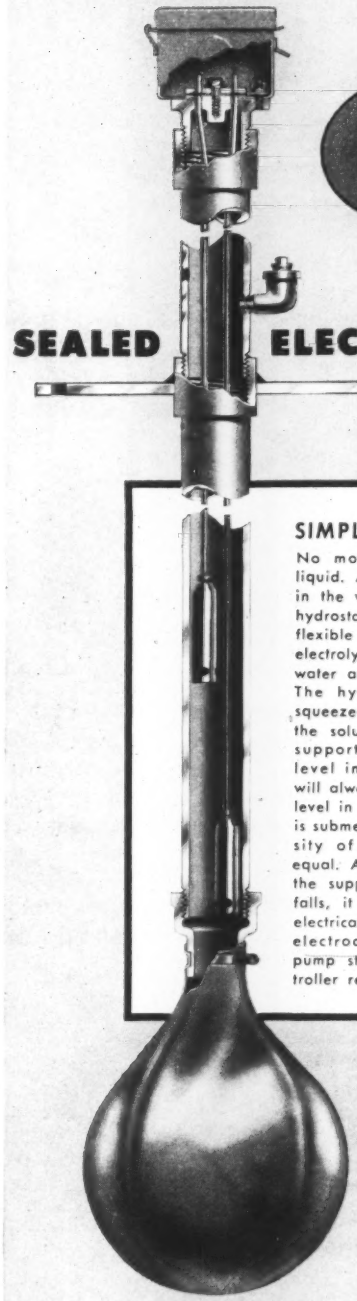
SEALED ELECTRODE FLOATLESS PUMP CONTROLLER

A new and valuable accessory for Sewage And Drainage Sump Pumps . . . exclusively available with "Chicago" Pumps.

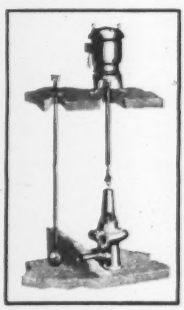


SIMPLE OPERATION

No moving parts in the liquid. As liquid level rises in the wet well it exerts a hydrostatic pressure on a flexible bulb filled with a electrolytic solution of clear water and copper sulphate. The hydrostatic pressure squeezes the bulb, causing the solution to rise in the support pipe. The liquid level in the support pipe will always equal the liquid level in which the controller is submerged, since the density of both liquids are equal. As the liquid within the support pipe rises and falls, it makes and breaks electrical circuits with the electrodes, activating the pump starters through controller relays.

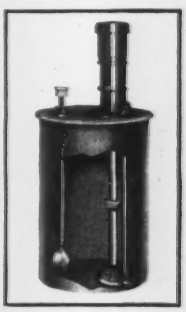
The SEALTRODE* Sealed Electrode Floatless Pump Controller has every advantage of other floatless controllers, plus these advantages of being sealed:

- Electrodes never become insulated and coated with grease, oil or soap.
- Electrodes are never affected by corrosive elements in sewage and drainage water.
- No moving parts in liquid.
- Low original cost . . . eliminates need for dupiex float switches and float guide pipes.
- Low maintenance cost.



TYPICAL PUMP APPLICATIONS

SEWAGE PUMP **SUMP PUMP**



PATENT No. 2,797,702

Write direct, or contact Chicago Pump Company Distributors located in most principal cities, for bulletins and complete engineering data.

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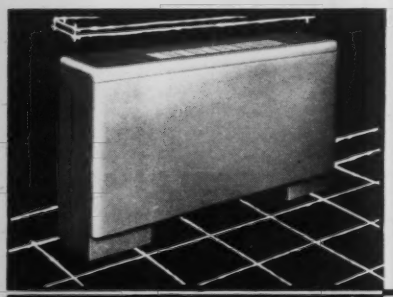
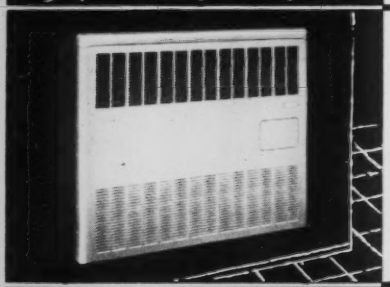
Airtherm

for quality, engineered heating, ventilating and air conditioning products

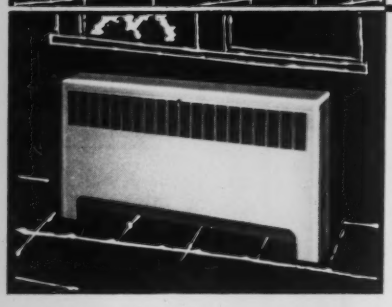


AIR CONDITIONING UNITS— perfect application for new construction or remodeling of offices, motels, apartments, schools, hospitals. Healthful all season conditioned air with recirculating and fresh air mixtures. Remote type for use with a central source of hot and chilled water.



CABINET UNIT HEATERS— with predominantly popular, more efficient direct drive. Entire unit constructed of 16 gauge steel. Sizes from 375 to 1630 CFM. Complete variety of types and mounting arrangements. Steam and hot water.

PROPELLER FAN UNIT HEATERS— 52 models of steam and hot water horizontal and vertical unit heaters. Capacity ranges from 22,750 to 555,000 BTU. Water coils available for high temperature drop requirements.



CONVECTORS — lowest cost installed wet heat. Versatile units combine attractive appearance with efficient operation.

Dependable supplier of quality heating, ventilating and air conditioning equipment for more than 30 years. For trouble-free, efficient performance, always specify AIRTHERM.

Write For Catalogs

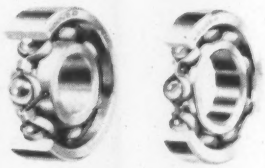
Airtherm **MANUFACTURING COMPANY**
702 South Spring Avenue, P. O. Box 7039
Saint Louis 77, Missouri

EQUIPMENT DEVELOPMENTS

Continued

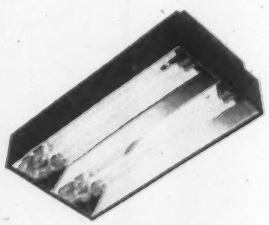
Portable Nibbler . . .

. . . operates with punch-and-die action on 3/16 in. copper, brass, and aluminum, 10 gage stainless and 8 gage mild steel at minimum radius of 6 in.; air motor driven, unit weighs 12 lb, available in five styles, may be mounted for bench work—*Fenway Machine Co., 3107 N. Broad St., Philadelphia 32, Pa.*



Ball bearings . . .

. . . in both English and metric unit sizes in the 1/8 to 1 1/2 in. shaft diam range, may be obtained in either open or shielded design, and with single or double seal in metric sizes; bulletin "112" available on request—*Hoover Ball and Bearing Co., Bearing Div., 5100 S. State Rd., Ann Arbor, Mich.*



Infrared Heater . . .

. . . in one, two, or three lamp models for 500 to 15,000 watt output; fixture lengths range from 10 1/2 to 55 1/2 in.; reflectors designed for filament temperatures in excess of 4000 F—*Luminator Inc., 120 N. Peoria St., Chicago 7, Ill.*

Rx FOR REXALL:

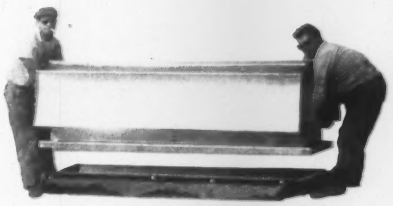
VENTILATION by COLT

Rexall Drug & Chemical Co. wanted maximum air movement at minimum cost in their new Santa Ana, California, plant. The specifying engineer selected Colt. You, too, can give your client more CFM of air movement without motors or operating costs with a Colt Installation. Get the Colt story today!

Huge battery of Colt SRC/3080 natural gravity ventilators, part of a recent installation for Rexall Drug & Chemical Co. in California.

Engineers and General Contractors: WM. J. MORAN CO., Alhambra, California, for the new Rexall plant. Air conditioning and ventilating contractors: BAKER ENGINEERING CO., Los Angeles.

Lightweight construction of Colt ventilators means easier handling and installation, no strain on the roof diaphragm. Standard base fits skylight pane or rectangular hole on any type roof. The Colt SRC/3000 Ventilator (shown here) gives an unrestricted free area of 14 sq. ft., weighs only 145 lbs. and is just 27" high.



(1) Low Silhouette
(2) Easy to handle and install
(3) Rugged Construction
(4) Long-Life Anti-Corrosive Hardened Aluminum
(5) Dependable, Powerful, High Exhaust Capacity

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☐ *Send Free Brochure "Some Aspects of Fire Prevention in Industrial Buildings" by M. J. Reaney*

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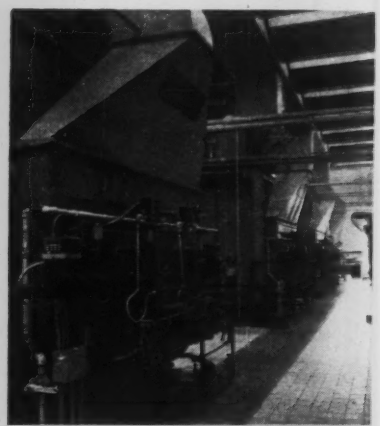
CITY _____ *ZONE* _____ *STATE* _____
TELEPHONE _____ HPA-14

655-acre "Terminal City"—New York International Airport

THE INTERNATIONAL SHOW PLACE for HIGH TEMPERATURE WATER

Central Heating and Refrigeration Plant keynotes the versatility of HTW



These four LFW-20 International-LaMont Generators have a combined capacity of 160,000,000 Btu/hr.

The unmatched economies of high temperature water are realized throughout the year at New York International Airport. In addition to heating the vast Terminal City, HTW (380° F. at outlet) produced by four International-LaMont Generators feeds nine absorption machines in the unique Central Heating and Refrigeration Plant—the first of its type. Visit it next time you stop at Idlewild.

International Airport is only one of the major HTW installations both here and abroad. To date, more than 130 International-LaMont High Temperature Water Generators are in operation with a total capacity exceeding THREE BILLION Btu/hr. All of these employ the proven LaMont principles of forced recirculation which permit temperature differential to 200° F. or more with no danger of thermal shock—the key to truly significant economies.

Take a closer look at HTW in terms of International-LaMont — the most experienced name in this rapidly growing field.

Get full details from your INTERNATIONAL DISTRICT REPRESENTATIVE or write for Bulletin 1600 today.

IBW BOILER BUILDERS SINCE 1886

THE INTERNATIONAL BOILER WORKS CO.

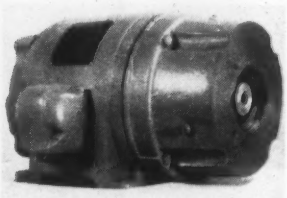
Steel Firebox Heating & Power Boilers Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products.

810 Spruce St. East Stroudsburg, Pa.

Manufactured and sold in Canada under agreement with CANADIAN VICKERS LTD. Montreal, P. Q.

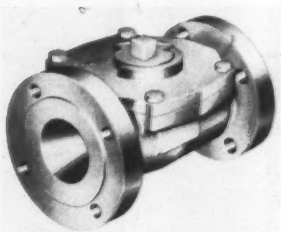
EQUIPMENT DEVELOPMENTS

Continued



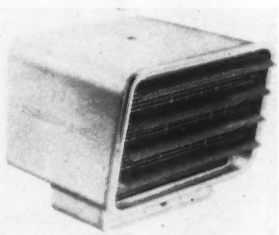
Hydraulic Pump Motor . . .

. . .in single and double end models, ¾ to 50 hp. with splined coupling; features enclosed housing, cast iron frame with mounting bracket designed to eliminate mounting base or adaptors—*U. S. Electrical Motors Inc., Box 2058 Terminal Annex, Los Angeles 54, Calif.*



Ball Valve . . .

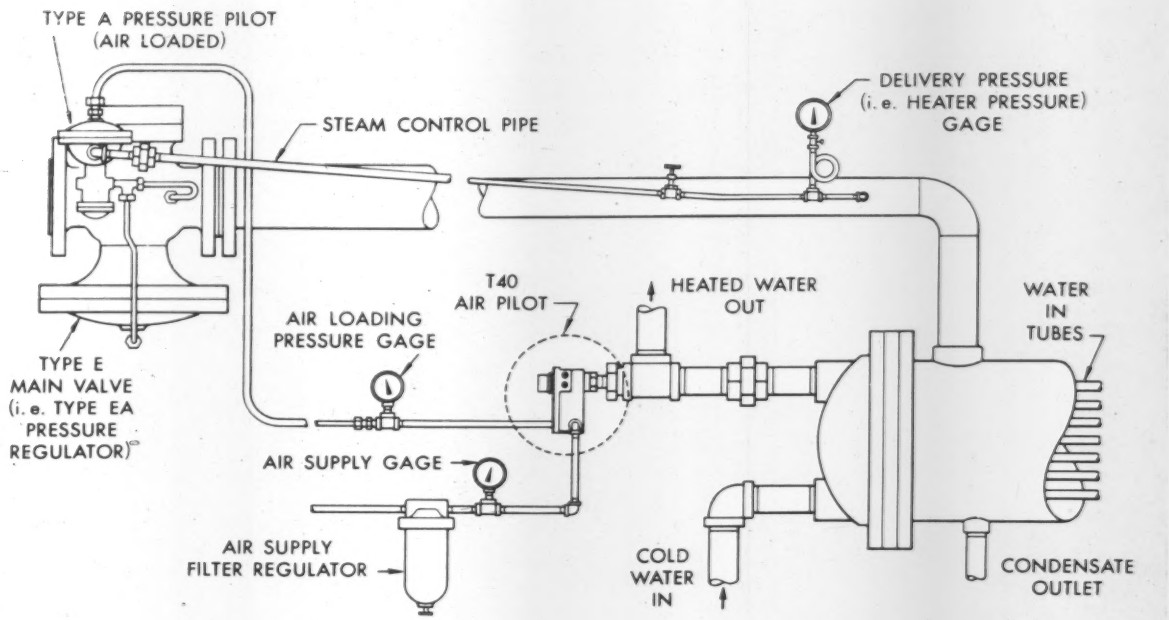
. . .for industrial uses available in sizes from 1 to 10 in., has ball mounted in fixed bearings, can be disassembled and serviced without removal from line; for temperatures from −20 to +400 F and pressures from 0 to 300 psi, in various materials—*Hydromatics, Inc., Livingston, N. J.*



Unit Heater . . .

. . .electric, in 5 and 7½ kw models, features ⅝ in. stainless steel sheath type heating element, thermal cutout and manual reset control; all internal components may be removed as single unit for servicing—*Berko Electric Mfg. Corp., 212-10 Jamaica Ave., Queens Village 28, N.Y.*

New Spence Temperature Control System Gives Unusual Control Accuracy



TYPE EAT40 AIR-CONTROL TEMPERATURE REGULATOR (Patent Pending)

In a recent installation the new Spence air-control temperature regulating system provided:

- ±5°F control accuracy under wide and instantaneous load swings of 210 to 80 gallons per minute.
- Up to 50% reduction in cost as compared to instrument systems of similar accuracy.

This unique cascade-type control with throttling range adjustment independent of maximum heater pressure was developed to meet today's demand for greater control accuracy.

Additional features of the new Spence Temperature Control System include:

- 200°F wide adjustable temperature range
- Adjustable speed of steam pressure change
- Over and under temperature protection
- Pressure limit control
- Fast response
- Very low air consumption
- Field reversible for heating or cooling

The Spence Type EAT Air Control Temperature System, when properly installed, will tame wide ranging, fast changing loads of instantaneous heaters and modern heat exchangers. The cascade principle plus the use of an extremely fast responding bi-metal temperature sensing element reduce time lags and provide control stability.

Here's how the new Spence system operates:

Quick response is based on a bi-metal temperature sensing element. Temperature pilot continuously regulates a loading air pressure.

This loading signal, when applied to a pressure regulator to reflect heater temperatures, causes it to adjust the main valve as changes in load require.

Spence has also developed a new pressure control system based on this same cascade principle. This system has a control accuracy of ½ psi or better from positive pressures through the vacuum range to 30" Hg.

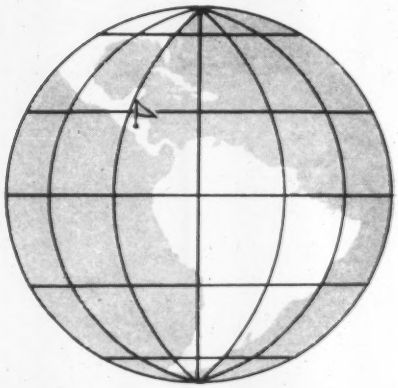
For complete information on these new air controlled temperature and pressure control systems, write for your copy of Bulletin 9.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York
SE-149

Engineering the temperature...

with RECOLD in El Salvador

Recold Multizone units, which provide 45,000 CFM of heating and cooling for the new Banco Central de Reserva in tropical San Salvador, meet the extremes of climatic conditions the world over.



For the answer to your air conditioning needs, contact:

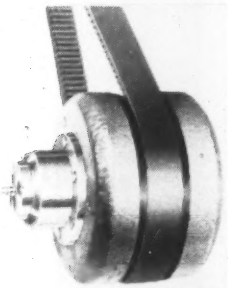
RECOLD **CORPORATION**

7250 East Slauson Avenue, Los Angeles 22, California

RECOLD

EQUIPMENT DEVELOPMENTS

Continued



Variable Speed Pulley . . .

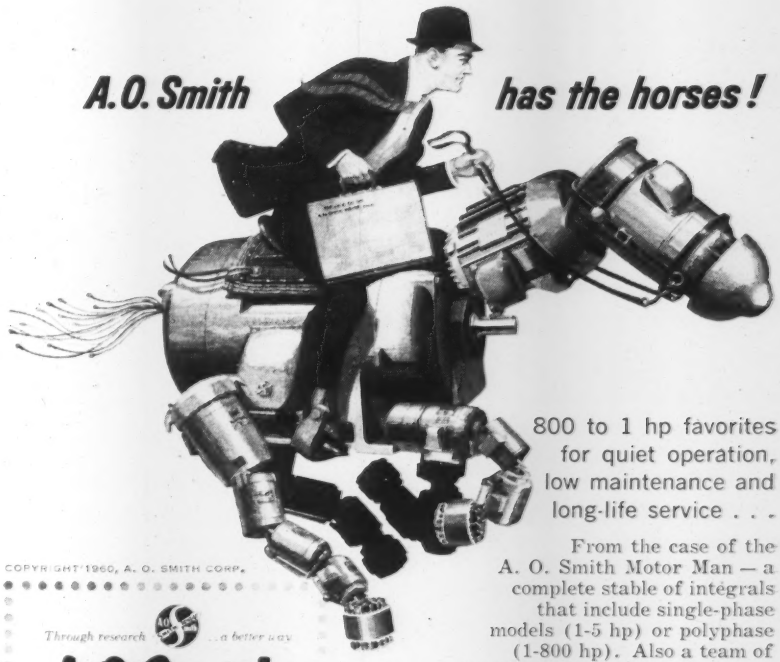
. . . in five types for 1 to 5 hp motors at 1750 rpm and ¾ to 3¼ hp motors at 1150 rpm; provide speed ratios of 3 to 1 with ⅞ to 1-7/16 in. V-belts; cam assembly gives constant overload speeds without belt compression, according to manufacturer—*Lovejoy Flexible Coupling Co., 4949H West Lake St., Chicago 11, Ill.*

Diamond Bits . . .

. . . in standard diameter from ¼ in. to 11 in., and in 11½, 12, and 18 in. core lengths; made in resettable and throwaway whole diamond, and diamond particle models; brochure available on request—*J. K. Smit & Sons, Inc., Murray Hill, N.J.*

Pressure Gage . . .

. . . for any media not corrosive to brass or bronze in 20 standard ranges 0 to 15 up to 0 to 1000 psi and various compound ranges, has 4½ in. dial mounted directly on movement, ¼ in. bottom connection—*American Chain & Cable Co., Helicoid Gage Div., Bridgeport 2, Conn.*



800 to 1 hp favorites for quiet operation, low maintenance and long-life service . . .

From the case of the A. O. Smith Motor Man — a complete stable of integrals that include single-phase models (1-5 hp) or polyphase (1-800 hp). Also a team of fractional-hp motors. All are sure bets to give top performance over the long, long haul.

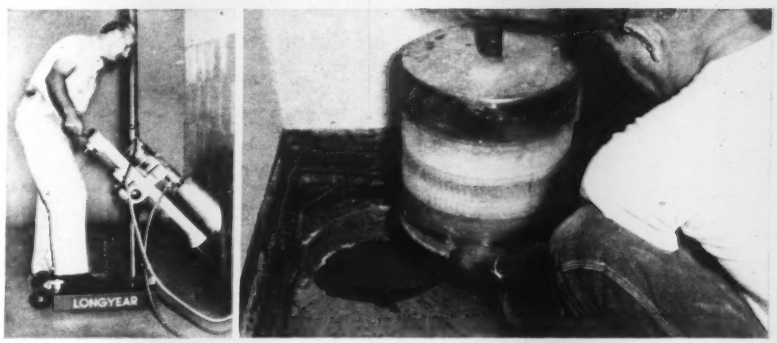
And there's an A. O. Smith Motor Man near you — champing at the bit to give you 24-hour action on all parts and service orders.

COPYRIGHT 1960, A. O. SMITH CORP.

Through research ... a better way

A.O.Smith
CORPORATION
ELECTRIC MOTORS
Tipp City, Ohio
A. O. SMITH INTERNATIONAL, S.A.
Milwaukee 1, Wisconsin, U.S.A.

CUTTING POWER!



14-Inch Holes in 5-10 Minutes!

Hundreds of 14-inch holes and many smaller ones were drilled with Longyear diamond bits through 5-inch terrazzo and reinforced concrete floors to air condition a 32-story office building. Each of the 14-inch holes took only 5-10 minutes of actual drilling time, and every Longyear bit drilled 100-120 holes! Every opening was clean and even, requiring no patch-up, and total cost of this big drilling job was surprisingly low. See your Longyear dealer and find out how the new Longyear industrial diamond drills can knock down your drilling costs.

Adv-167

Longyear

E. J. LONGYEAR CO.
76 S. Eight Street
Minneapolis 2, Minnesota
Phone: FEderal 9-7631

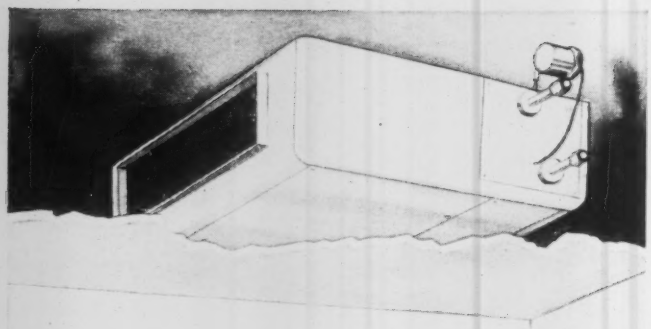
Please send complete information on Longyear Diamond Bits and Industrial Drills. Also the name of my nearest Longyear dealer.

NAME _____

FIRM _____

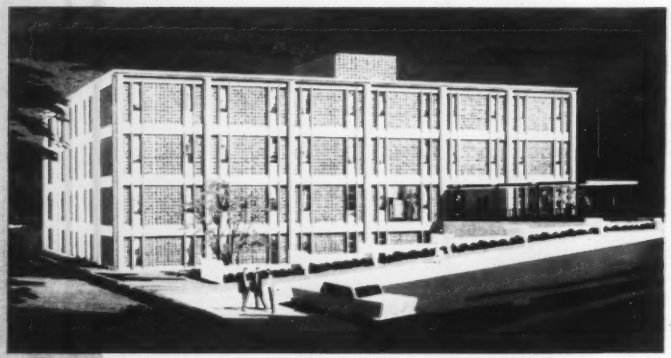
ADDRESS _____

TOWN _____ STATE _____



DOCTORS NORTH-ROADS BUILDING
Dellwood, Mo.

Architects: Smith & Entzeroth
Mechanical Engineers: Albert Rich Co.
General Contractor: Cousins Construction Co.
Mechanical Contractor: Condaire, Incorporated



Unique use of *Marlo* fan-coil units in handsome new doctors' building

The versatility of Marlo "Seazonaire" remote room air conditioning units is graphically demonstrated in the new Doctors North-Roads Building in suburban St. Louis.

In this installation, the "Seazonaires" were recessed above a removable furred ceiling and equipped with flexible ductwork leading to ceiling diffusers. Thirty-six "Seazonaires" were installed, one unit for each suite, each with its own thermostatic and fan control and fresh air duct from the outside wall.

By using this unique system — one of the first of its kind—the architects and engineers were able to produce a building of quality design and construction without increasing initial cost and offering important savings in operating costs.

Write for 16-page illustrated brochure on Marlo "Seazonaire" remote room air conditioning units. Contains photographs and drawings of all models available, construction and performance details, examples of typical installations.

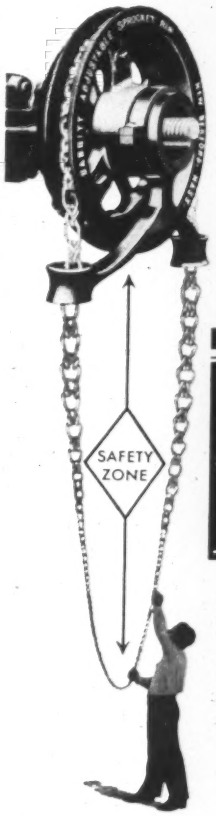
Marlo coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment Since 1925

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE



The distance between the floor of your plant and your overhead valves is a DANGER ZONE when piled up boxes or even ladders are used to reach the valves.

Turn it into a SAFETY ZONE — equip your overhead valves with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. If your supplier does not carry them, contact us direct.

Babbitt

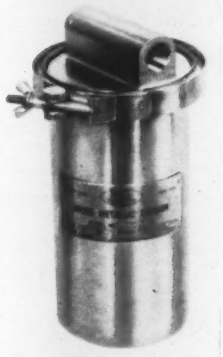
168 9

STEAM SPECIALTY CO.

8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

EQUIPMENT DEVELOPMENTS

Continued

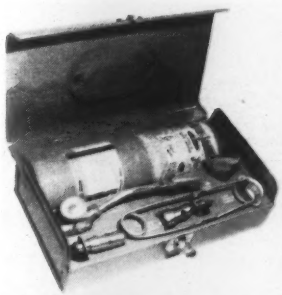


Liquid Filter . . .

. . . for pipeline pressures to 300 psi or to 10,000 psi on special design, in several pipe sizes; cylindrical, bayonet or star-type filter elements, of stainless steel, monel, nickel and other material; features clamp closure for easy cleaning, filtration to 2 microns—*Pall Corp., Micro Metallic Div., 30 Sea Cliff Ave., Glen Cove, N.Y.*

Motor Starter . . .

. . . 50 amp, for a-c installations features quiet magnet structure, low power requirements, protective thermal overload relay, accessible circuit terminals—*Cutler-Hammer Inc., 421 N. 12th St., Milwaukee 1, Wis.*



Utility Torches . . .

. . . propane fueled, for soft soldering, copper tube sweating, etc., features quick starting, 15-hr disposable cylinder; available with single cylinder in various tip assemblies or in kit with accessories—*Air Reduction Co., Inc., 150 E. 42nd St., New York 17, N.Y.*

4-D

WROUGHT IRON RADIANT HEATING SYSTEMS whip corrosion, cut heating costs

WHERE TO USE IT:

- schools
- churches
- hospitals
- toll houses
- administration buildings
- commercial buildings
- aircraft hangars
- garages
- lobbies
- locker rooms

WHY 4-D WROUGHT IRON?

- built-in corrosion resistance
- good heat transfer properties
- rugged strength
- crushproof
- expansion coefficient same as concrete
- good bending properties
- welds soundly, easily
- leakproof
- lowest cost per year of service

Write for technical data on specific applications

BYERS 4-D WROUGHT IRON

Tubular and Flat Rolled Products

A. M. Byers Co., Pittsburgh 22, Pa.

$11,000

in fuel savings a year

when Space Heaters replaced steam

This was the problem . . . a plant expansion program had added many square feet to existing structures, plus two new buildings. The present steam heating system was inadequate, so management took a long, hard look at heating costs. Rejuvenating the present boiler or installing a new one large enough to provide both heat and process steam involved a major expenditure. In addition, fuel and maintenance costs were high.

This was the solution . . . sixteen Dravo Warm Air Space Heaters of various sizes were installed. Now all working areas in the plant are held at a comfortable 70°, including offices and receiving room. Cold air is drawn into the heaters at floor level, and discharged *above* workers' heads. Warm air is retained in the work area instead of rising to the roof.

These were the results . . . Fuel savings alone amounted to $11,000 per year, a reduction of 48%. In addition, the costs of full-time boiler room employees, and of boiler and steam line maintenance are saved. Since each heater is controlled by an individual thermostat, working conditions are kept at optimum. In the summer, fresh air is circulated by the heater fans.

Interested . . . in what Dravo Counterflo Heaters can do for you? Mail the coupon for full information on the Case Study outlined above, and on money-saving Dravo Heaters.

DRAVO

CORPORATION

Department H-12, Room M-214
Pittsburgh 25, Pa.

Send me free copy of 12-page report on warm air space heating and the facts on the company mentioned above.

Name_____

Company_____

Address_____

City_____ Zone____ State____

RECENT TRADE LITERATURE . . .

▸ *ABRASIVE TOOLS* — for deburring, smoothing, polishing, described in manual with illustrated applications and recommended operating instructions. *Cratex Mfg. Co., Inc., 1600 Rollins Rd., Burlingame, Calif.*

▸ *ACOUSTICAL INSULATION* — for noise-generating equipment treated in brochure which outlines general problems of absorption, damping, transmission and isolation, with data for selection, sizing, and specification of glass fiber materials. *Owens-Corning Fiberglas Corp., Dept. 910, Toledo, O.*

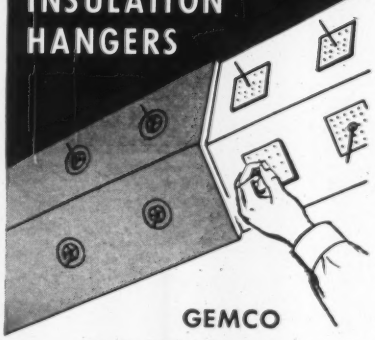
▸ *ADSORPTIVE AIR CONDITIONER* — for condensation control, drying and processing applications, applicable to hospital requirements, described in bulletin "K-160." *Surface Combustion Div., Midland-Ross Corp., 2375 Dorr St., Toledo 1, O.*

▸ *AIR COOLED CONDENSERS* — types and construction features described in bulletin "AC-102" with operating characteristics and suggested specifications. *Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pa.*

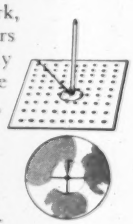
▸ *AIR FILTER* — manual pull-down type with glass fiber medium; brochure gives physical and operating characteristics, tabular specification chart. *Air Devices, Inc., 185 Madison Ave., New York 16, N.Y.*

▸ *AIR FILTERS* — for replacement purposes, of open-end cube design with retaining basket or flat type, illustrated, with sizing charts and typical arrangements in bulletins "A" and "B". *Union Carbide Development Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N.Y.*

SAVE TIME— SAVE MONEY
with these dependable INSULATION HANGERS

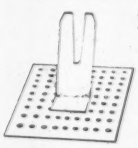


GEMCO
Spindle Hangers and W-A Self-Locking Washers



Ideal for insulation work, Gemco Spindle Hangers are easily and quickly installed . . . with positive adhesion to concrete, brick or metal. W-A Self-Locking Washers pressed over spindles with minimum effort and lock insulation securely in place.

GEMCO Pronged Hangers



Designed especially for supporting various types of block insulation. Easily applied for positive adhesion. Prongs (available in various lengths from 1 3/16" to 6 7/8") bend over to hold insulation firmly in place.

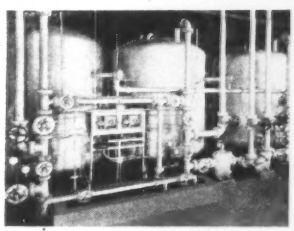
TUFF-WELD Nylon Hangers

Two-piece hangers . . . with bases of tough, mold nylon and spindles of metal. Made especially for smooth surfaces. Spindles snapped into bases as needed; reduces inventory, storage space, freight costs. W-A Self-locking washers hold insulation securely in place.

TUFF-BOND Quik-Set Adhesive (for smooth or slightly irregular surfaces) and Improved General Purpose Adhesive (for rougher surfaces) assure permanent adhesion of hangers when used as directed. Write or wire for details and specifications.

GOODLOE E. MOORE
INCORPORATED
DANVILLE 28, ILLINOIS

Bruner equipment supplies soft water for Michigan State University's Kellogg Center, including the new $500,000 wing (above). Consulting Engineers for the Center: Kenneth Phelps, Ann Arbor; Gene Stender, Battle Creek. Architect: L. J. Sarvis, Battle Creek. Plumbing Contractors: R. L. Spitzley Co., Detroit; J. A. Dart Co., Lansing; United Piping & Erecting Co., Lansing.



BRUNER Water Softeners protect plumbing investments at Kellogg Center and 10 other Michigan State buildings

Leading engineers across the country specify Bruner water softeners and filters, America's most complete line. Full information is available from Bruner Sales Offices in all major cities. Bruner Corporation, Milwaukee 9, Wisconsin.

BRUNER

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

4-D

WROUGHT IRON PIPE SOIL, WASTE, VENTS AND DOWNSPOUTS cuts maintenance/ installation costs

HERE'S WHY:

- optimum corrosion resistance
- needs no protective coating
- meets building code requirements
- resists shock and vibration
- saves space as Durham system
- long random lengths available
- fewer joints required
- fewer hangers needed
- less labor expended
- leak-proof sanitary joints
- no internal flaking, clogging
- low cost per year of service

Write for technical data on specific applications

BYERS 4-D WROUGHT IRON

Tubular and Flat Rolled Products

A. M. Byers Co., Pittsburgh 22, Pa.

RECENT TRADE LITERATURE

Continued

▸ *ALUMINUM GRILLES* — for sidewall, sill, floor location; brochure gives style designations, performance data, test procedure, illustrates border styles. *Air Devices, Inc., 185 Madison Ave., New York 16, N.Y.*

▸ *ARC WELDER* — in four models d-c or a-c/d-c welding current featured in data sheet "NH-179" with dimensions and specifications, optional equipment. *National Cylinder Gas Div., Chemetron Corp., 840 N. Michigan Ave., Chicago 11, Ill.*

▸ *BLIND RIVETS* — and developed methods of fastening use presented in illustrated catalog, with design data and selection chart. *"Pop" Rivet Div., United Shoe Machinery Corp., Shelton, Conn.*

▸ *CONDENSATE RETURN* — reprint "126" said to present a solution to problem of steam latent heat transfer for various equipment. *Cochrane Corp., 17th St. Below Allegheny Ave., Philadelphia 32, Pa.*

▸ *CORROSION INHIBITOR* — for cooling and heating systems presented in bulletin "HSP-922" with illustrations, case histories. *Hagan Chemicals & Controls, Inc., Hagan Bldg., Box 1346, Pittsburgh 30, Pa.*

▸ *DATA RECORDER* — for temperature, pressure, flow, humidity etc., in various capacities, optional memory units and alarm systems, described in new brochure. *Hanson-Gorrill-Brian, Inc., Glen Cove, N.Y.*

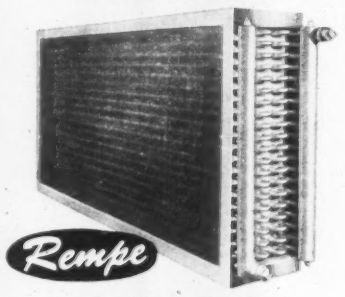
▸ *DEODORIZER* — employing electrostatic principal, in several models for various industrial-institutional applications described in bulletin "A-60." *Morris Deodorizers, Inc., 2819 Broadway, N.E., Knoxville 17, Tenn.*

REMPE

Heat Transfer Equipment

HEATING AND COOLING

FIN COILS



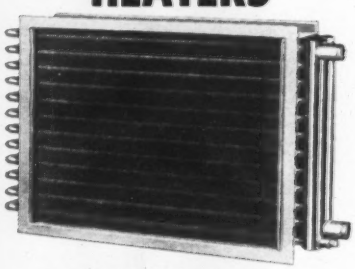
For Air-Conditioning Heating and Refrigeration

Double headered coils for use with hot water for winter heating or chilled water for summer cooling. Designed for normal or high temperature hot water systems . . . also liquid refrigerants for temperatures as low as minus 200° F. Available in copper or hot galvanized steel.

Any style . . . Any size

STEAM BLEED

HEATERS



For Residential, Commercial or Industrial Applications

This is the popular Rempe Hi-Cap line of heating coils. Equipped with the exclusive "Defrost-Tap" to keep coil warm during steam off-cycle and prevent freeze-up.

Single or double row designs available . . . any face area desired.

Eight, collared, Aluminum fins per inch on copper tube. Heavy steel casings.

Engineering Data Book

Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY

342 N. Sacramento Blvd. • Chicago 12, Ill.

Easy as wrapping a bun around a weenie

LABOR COSTS FOR INSULATING LINES CUT IN HALF BY B.F.GOODRICH CELL-TITE INSULATION TUBING

EVEN when pipe has already been connected, B.F.Goodrich insulation tubing can be slit, snapped on and cemented in seconds. And, if you prefer, you can get it pre-slit for even faster installation. Slitting is unnecessary for new lines—it slips on straight or bent pipe as easily as a ring on your finger. Installation is so fast that labor costs for insulating pipe can be cut 50% or more over old-fashioned twine-wrapping, skirting and other slower methods.

B.F.Goodrich insulation tubing is made of a tough, flexible rubber with millions of uniform, non-connecting cells that seal out air and moisture. It can be used for insulating pipes carrying hot or cold liquids at temperatures ranging from —20°F to 200°F. Clean and easy to work with, doesn't rub off, chip or crumble. It comes in 6-foot lengths, in many wall thicknesses, that are easy to handle, easy to store.

This BFG insulation is also self-extinguishing, so it can be installed on copper tubing before sweat fittings are made—tubing is merely pushed back and held by clamps while joint is soldered.

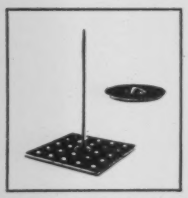
Try this labor-saving insulation on your next job. For full information on BFG insulation tubing, call your B.F.Goodrich distributor, or contact *The B.F.Goodrich Company, 181 Derby Place, Shelton, Conn.*

INSULATION TUBING BY B.F.Goodrich

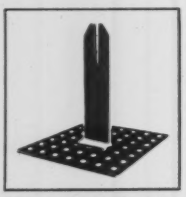
INSULATION INSTALLED FAST

WITH MIRACLE SURFACE ANCHORS

Use Miracle Surface Anchors, bonded with Miracle Anchor Adhesives, to provide firm support for block, board, or blanket type insulation. Eliminates drilling and welding. You save man hours, cut costs way down.



Use Spindle Anchors for bonding fibrous glass batts, mineral wool to ducts, walls, ceilings. Lock washer holds insulation firmly in place.



Use Pronged Anchors for bonding block insulation such as cellular glass. Pronged Anchors are set between rows of blocks and then prongs are bent over.

FREE

Valuable, informative engineers and architects bulletins giving details and complete specification data. Yours on request.

MIRACLE SURFACE ANCHORS

are manufactured by

DEVICES • Division of

MIRACLE ADHESIVES CORP.

250 Pettit Avenue

Bellmore, Long Island, New York

RECENT TRADE LITERATURE

Continued

▸ *DIAMOND DRILLS* — machines, bits, and accessories itemized in bulletin, with illustrations. *Truco Masonry Drilling Div., Wheel Trueing Tool Co., 3200 W. Davison, Detroit 38, Mich.*

▸ *DIAPHRAGM VALVES* — for variety of control applications, in various types, sizes, materials; catalog lists and illustrates line, with specifications and performance data. *Warren Engineering Co., Div., Warren Automatic Controls Corp., Route 24, Broadway, N.J.*

▸ *DIFFUSERS* — in variety of types and sizes including circular, square, straight-line, perforated, etc., described in 8 catalogs with dimensional drawings and performance data. *Anemostat Corp. of America, 10 E. 39th St., New York 16, N.Y.*

▸ *DIRECT FIRED HEATERS* — for industrial applications covered in text which gives explanations of types and installations, methods of heat loss calculation, fuel piping, mechanical conversion tables. *Lennox Industries, Inc., Dept. I, Marshalltown, Ia.*

▸ *DUST COLLECTORS* — industrial application list, illustrations, type and efficiency nomograms, dimensional and physical characteristics presented in bulletin "1828." *American Standard Industrial Div., Detroit 32, Mich.*

▸ *ELECTRIC HEATERS* — for wall mounted convection systems; bulletin "L-1251" includes sample architectural specifications and available model listing. *Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.*

▸ *ELECTRIC HEATING* — for churches covered in bulletin "F00-102" with line of heaters and controls described and illustrated; with representative installations and case history. *Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.*

4-D

WROUGHT IRON STEAM RETURN LINES NIP CORROSION IN THE BUD

What steam condensate is:

Steam condensate is a hot distilled water with no hardness or mineral content to form a protective coating over metal surfaces. Non-condensable gases are immediately absorbed by the condensate, making it extremely corrosive.

What steam condensate does:

Depending upon the percentage of free CO_2 plus O_2 contained in the steam, the corrosive condensate may cause grooving, channeling, pitting, or actual penetration of the pipe wall. Build-up of insoluble products of corrosion may plug the pipe and render it useless.

How to combat steam condensate:

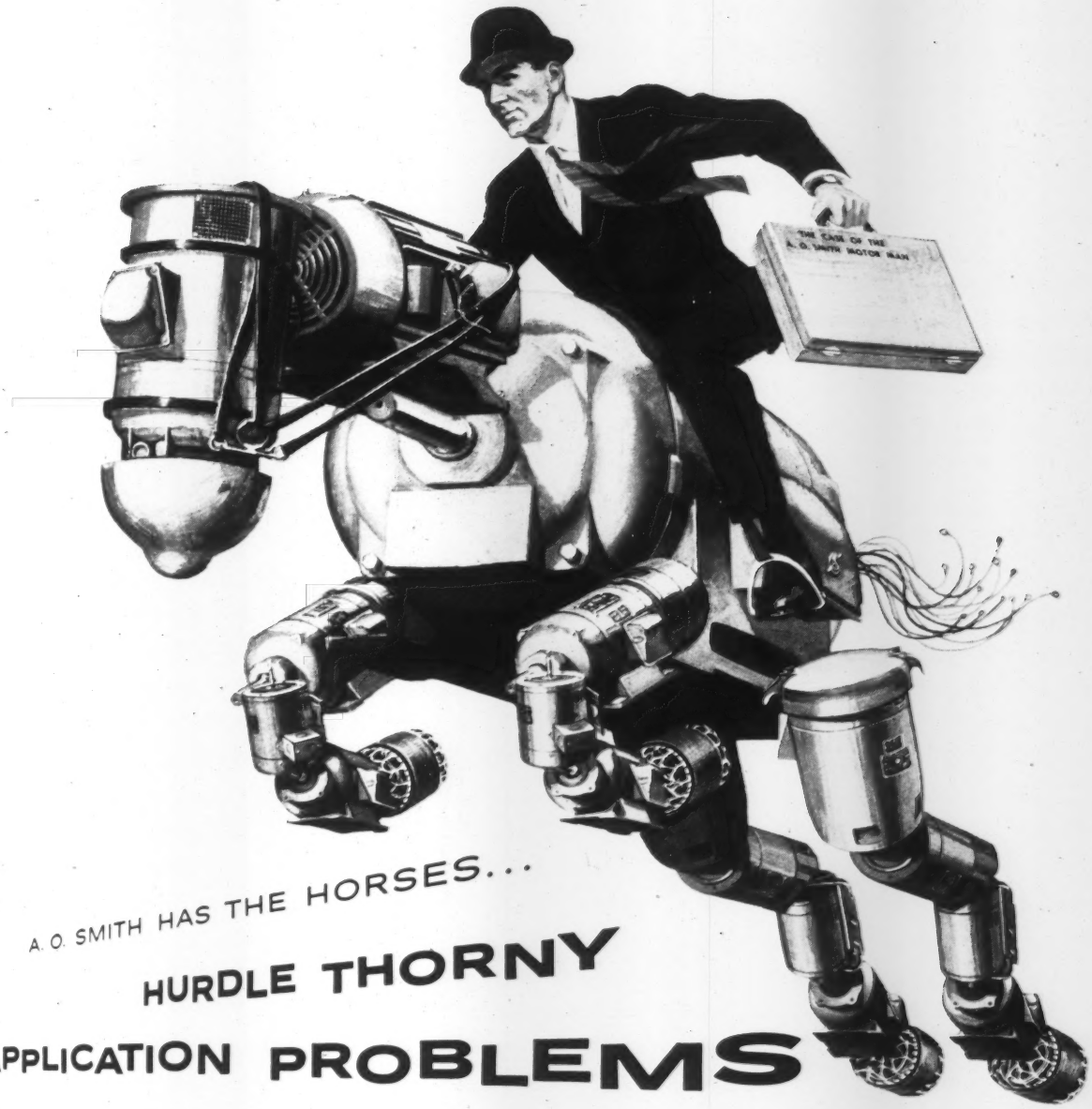
4-D Wrought Iron's corrosion-blocking film forms around the interior walls of condensate lines encouraging long, maintenance-free service. The high purity base metal, laced throughout with non-rusting glasslike iron silicate fibers, acts as a stubborn deterrent to condensate corrosion.

Write for Special Report on Steam Condensate Lines

BYERS 4-D WROUGHT IRON

Tubular and Flat Rolled Products

A. M. Byers Co., Pittsburgh 22, Pa.



A. O. SMITH HAS THE HORSES...

HURDLE THORNY APPLICATION PROBLEMS

From the case of the A. O. Smith Motor Man

...a line of 800 to 1 hp favorites, built to make tough application problems seem easy

When it comes to building integral-motor-powered equipment, *make sure of your horsepower source!* Before you specify any motor brand, consult with your A. O. Smith Motor Man. He'll show you how the horses of A. O. Smith (single-phase integrals — 1-5 hp — polyphase — 1-800 hp) help users surmount application barriers.

And A. O. Smith delivers the horses that deliver the goods!

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Through research ... *a better way*

A.O.Smith
CORPORATION
ELECTRIC MOTORS
Tipp City, Ohio

A. O. SMITH INTERNATIONAL S. A.
Milwaukee 1, Wisconsin, U. S. A.

TOP ECONOMY, EFFICIENCY

MUELLER CLIMATROL
Gas Suspended Unit Heater

- Complete size range from 25,000 to 225,000 BTU/hr.
- Efficient, safe, all-welded, tubular-design heat exchanger
- Quality, trouble-free, cast-iron drilled-port burner
- Convenient triple-duty lifting and hanging brackets
- Automatic fan and limit control plus summer switch
- AGA approved for Natural, Mixed, Mfd., Propane gas
- Shipped assembled, pre-wired, and test fired.

Write for free information today.

Mueller Climatrol
DIVISION OF WORTHINGTON

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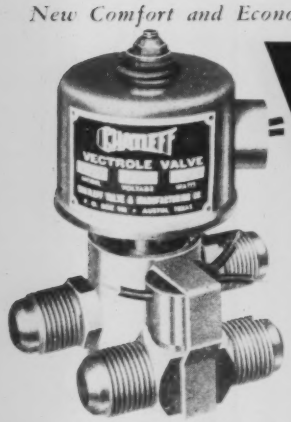
THE COMPLETE LINE FOR INDOOR CLIMATE CONTROL

MC-44

New Comfort and Economy For Individual Forced Air Convectors.



The Vectrole
Water Diverting Valve

gives you year 'round comfort automation at a reasonable price. The Chatleff Vectrole Valve, Switching Element and Thermostat give you a complete comfort control system at a tremendous saving.

Be sure to visit our space at the Western Air Conditioning and Heating show in Los Angeles, and our Hospitality Suite at the Statler-Hilton.

Please send me complete information on the Chatleff Vectrole Valve.

Name _____

Address _____ City _____

CHATLEFF
VALVE & MANUFACTURING CO.
205 Industrial Blvd. Austin 4, Texas

RECENT TRADE LITERATURE
Continued

▶ *ELECTRIC MOTORS* — fractional hp, capacitor start, split phase, permanent-split capacitor, shaded-pole and polyphase types in NEMA frame sizes 48 through 56, itemized in bulletin "GEA-6424A" *General Electric Co., 1 River Rd., Schenectady 5, N.Y.*

▶ *ENVIRONMENTAL TEST EQUIPMENT* — said to duplicate global climatic conditions described in catalog "560" with illustrations, applications. *American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.*

▶ *EVAPORATIVE CONDENSER* — for vertical air flow applications in 5 to 40 ton sizes presented in catalog "34C9a" with sizing explanation for multi-circuit installation. *Recold Corp., 7250 E. Slauson Ave., Los Angeles 22, Calif.*

▶ *EVAPORATIVE CONDENSER* — for ammonia or fluorinated hydrocarbon systems from 12 to approximately 425 tons capacity, with photographs and construction diagrams, physical data presented in catalog "C-2." *Niagara Blower Co., 405 Lexington Ave., New York 17, N.Y.*

▶ *EXPANSION JOINTS* — rubber, for pressure, pressure-vacuum, and vacuum applications described in folder which compares materials and their properties, gives characteristics and ordering information with dimensional chart. *Mercer Rubber Co., Hamilton Square, N.J.*

▶ *EXPANSION JOINTS* — rubber, for various water-system applications described in catalog "850" with explanation of advantages, special uses; with additional section on line of flanged flexible pipe. *General Rubber Corp., 57 Summit St., Tenafly, N.J.*

PHYSICAL PROPERTIES	ARMAFLEX 22	BRAND A	BRAND B	BRAND C	BRAND D
LOW DENSITY (less than 7.5 lbs. per cu. ft.)	YES	NO	YES	YES	YES
LOW WATER VAPOR TRANSMISSION (less than .15 Perm)	YES	NO	NO	YES	NO
LOW WATER ABSORPTION (less than 3% by volume—28 days)	YES	NO	NO	YES	YES
DIMENSIONALLY STABLE AT 200° F. (less than 5% lineal shrinkage—28 days)	YES	YES	YES	NO	NO
DIMENSIONALLY STABLE AT 220° F. (less than 5% lineal shrinkage—28 days)	YES	NO	NO	NO	NO
NEGLIGIBLE ODOR	YES	NO	NO	(?)	NO
SELF-EXTINGUISHING	YES	YES	YES	(?)	YES
OZONE RESISTANCE	YES	YES	YES	YES	YES
SMOOTH SURFACE	YES	(?)	(?)	(?)	YES

Properties evaluated by tests at Armstrong Research and Development Center
(?) indicates results are inconclusive or classification a matter of individual judgment

What's better about the new Armstrong Armaflex 22?

This chart tells you at a glance why the improved Armaflex 22 gives superior performance on pipe covering work. New Armaflex 22 features a temperature range from below zero to 220° F.; a super-smooth exterior surface; and greater toughness and durability. For complete information on this fine quality flexible foamed plastic insulation, send for new booklet. Write to Armstrong Cork Company, 2204 Sherman Street, Lancaster, Pennsylvania.

Armstrong INSULATIONS

1860-1960 Beginning our second century of progress

RECENT TRADE LITERATURE
Continued

▸ *HIGH VELOCITY AIR DUCT* — spiral wound, in 3 to 12 in. diam zinc-coated steel, with fittings; complete specifications, strength comparison charts, featured in new literature. *United Sheet Metal Co., Inc., 540 S. Drexel Ave., Columbus 9, O.*

▸ *ICE RINK PIPING* — discussed in brochure featuring steel-pipe installations, with illustrations, list of installed systems. *The National Supply Co., 2 Gateway Center, Pittsburgh 22, Pa.*

▸ *MECHANICAL PROPERTIES OF METALS* — discussed in summary technical report "STR-2446" with emphasis on test techniques employed to relate changes in lattice structure to tensile and yield strengths, ductility, hardness, other properties. *National Bureau of Standards, U.S. Department of Commerce, Washington 25, D.C.*

▸ *METAL COATING* — for anti-oxidation, corrosion, abrasion described in data steet "4.5" with physical, chemical, fabrication properties, application methods and specifications. *Wall Colmonoy Corp., Stainless Processing Div., 19345 John R. St., Detroit 3, Mich.*

▸ *METAL PUNCHES* — for mild steel to maximum ¼ in. thickness listed in catalog "U-95" with selector chart for maximum rectangular shapes available with various punch bodies. *Tool Products Corp., 377 Old Falls Blvd., North Tonawanda, N.Y.*

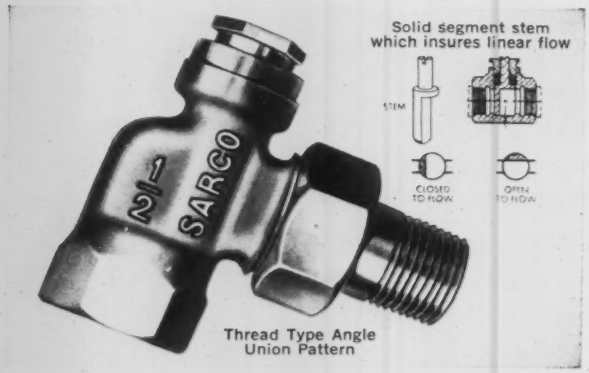
▸ *MOTOR OPERATED VALVES*— electric, in wide range of sizes and types, illustrated and described in bulletin "100" with specification charts, selection and application data. *Warren Engineering Co., Div., Warren Automatic Controls Corp., Route 24, Broadway, N.J.*

▸ *NATURAL GAS ENGINES* — for variety of applications featured in booklet "20173" with photographs and job stories, data charts. *Caterpillar Tractor Co., Industrial Engine Plant, Peoria, Ill.*

▸ *PACKAGED BOILERS* — bulletin "1145" describes forced draft boiler-burner units, with photographs and line drawings, ratings, dimensions, and data tables; with suggested specification, list of accessories. *American Standard Industrial Div., Detroit 32, Mich.*

▸ *PIPE BENDERS* — for ½ in. OD tube to 16 in. OD pipe, operate on ram principle; described in catalog with photographs, type and size specifications. *Wallace Supplies Mfg. Co., 1304 W. Diversey, Chicago 14, Ill.*

▸ *PIPE FITTING TOOLS* — including benders, power pumps, bits, pullers and others, cataloged in bulletin "E-240." *Greenlee Tool Co., Rockford, Ill.*



For positive control in balancing hot water systems, use

SARCO SOLID SEGMENT STEM BALANCING FITTINGS

Sarco Balancing Fittings with *solid segment* stems give you 3 big advantages. First, you get linear flow. Equal openings give you even throttling action that can save you hours in balancing systems.

Second, there's no obstruction to flow in the full open position. That means very little pressure drop through the fitting. Third, only Sarco Balancing Fittings are suitable for 200 psi water pressure.

Sarco Balancing Fittings are available in both thread and sweat type, all patterns. Write for Bulletin 221-B. 5923-F

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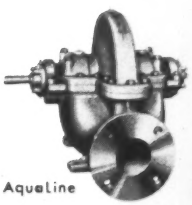
Whatever your needs in any of the above classifications . . . you can solve them quickly with a classified advertisement. The space rates are reasonable and results are quick. Closing date — the tenth of the month preceding issue.

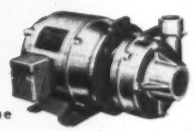
INSTALL THESE BETTER PUMPS WITH DOWN-TO-EARTH PRICE TAGS

PEERLESS PUMPS

PEERLESS END SUCTION AND SIDE SUCTION AIR CONDITIONING PUMPS COST LESS—LAST LONGER



AquaLine



Fluidyne

PEERLESS AQUALINE® Pumps are available in sizes to 8-inches. Capacities to 2600 gpm, heads to 280 feet. Temperatures to 250° F. Horizontal split case design allows quick inspection without disturbing piping.

PEERLESS FLUIDYNE® Pumps are compact end-suction design. Redi-Packed in 22 sizes from 1 x 2 x 6 to 2½ x 3 x 10, for immediate shipment. Heads to 230 feet, capacities to 300 gpm, motors from 1 to 15 hp.

Priced right – That's the first Peerless economic factor you find in every Peerless AquaLine and Fluidyne water handling pump.

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Versatile–Outdoors or indoors, Peerless AquaLine and Fluidyne pumps meet the needs of hundreds of water handling services. Chilled water, booster service, in-plant, and cooling systems of all types are but a few of the many applications for which these pumps are ideally suited.

Immediate Availability–Close-by regional warehouses, plus two big factories place these pumps at your job in shortest time possible.

Get the full story now on Peerless AquaLine and Fluidyne pumps. Send for more information today.

ATTENTION DEALERS: A limited number of Peerless AquaLine and Fluidyne pump dealerships are available. Please write for complete information.

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Distributors in principal cities. Consult your telephone directory.

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Gentlemen: Please send me immediately:

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- ☐ Bulletin B-2100 on Peerless AquaLine Pumps.
- ☐ Name and address of nearest Peerless Dealer.

Name_____

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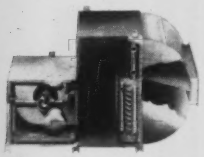
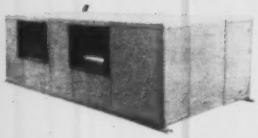
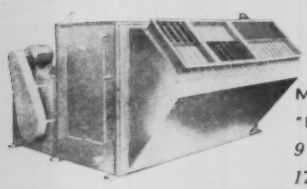
AIR MOVING MIGHT



HIGH-PRESSURE BLOW THRU: "HCD" AND "HPF". *10 models, 1750 thru 32,250 cfm.*

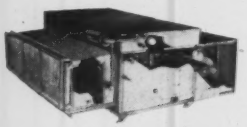
AIR HANDLING UNITS: "CSH" CEILING, "CSV" FLOOR-MOUNTED TYPES. *15 models, 600 thru 32,250 cfm.*

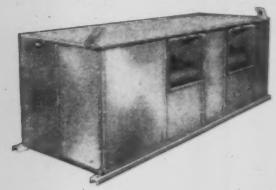




MULTIZONE TYPES: "FLEXAZONE". *9 sizes, horizontal or vertical. 1750 thru 32,250 cfm.*

HUMIDITY CONTROL UNITS: "SCD", *Sprayed Coil; horizontal or vertical 15 sizes; 668 thru 32,250 cfm.*





VENTILATING UNITS: "AM". *15 sizes. 600 thru 32,250 cfm.*

REQUEST LITERATURE Z-1

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RECENT TRADE LITERATURE

Continued

▸ *PIPE INSULATION* — news bulletin "Vol. 3, No. 2" describes housing project piping system with emphasis on underground insulation, plus forms for use in semi-plastic insulating of underground piping. *American Gilsonite Co. Municipal Airport P.O. Box 15, Salt Lake City, Utah.*

▸ *PIPE THREAD SEALER* — brochure containing samples describes industrial and commercial applications for plastic compound said to provide leak protection for all types of threaded connections. *Friesland Plastics Co., Friesland, Wis.*

▸ *POWER VENTILATORS* — bulletin "RPV-I" describes line of round units of asphalt-protected metal, with table of capacities, base-types available. *Bowman Steel Corp., Box 2129, Pittsburgh 30, Pa.*

▸ *RADIAL COMPRESSORS* — catalog "ME-120" gives capacity ratings, schematics, roughing-in dimensions for available models. *Airtemp Div., Chrysler Corp., P.O. Box 1037, Dayton 1, O.*

▸ *RADIANT HEATERS* — of tubular or glass-panel design for industrial heating-drying applications illustrated in catalog "PE-70" with physical and operating characteristics, installation precautions, maintenance instructions. *Corning Glass Works, Plant Equipment Sales Dept., Corning, N.Y.*

▸ *RADIATORS* — covered in catalog which gives information on equipment selection, tables of sizes and ratings, roughing-in dimensions, piping layout suggestions. *Shaw-Perkins Mfg. Co., 201 E. Carson St., Pittsburgh 19, Pa.*

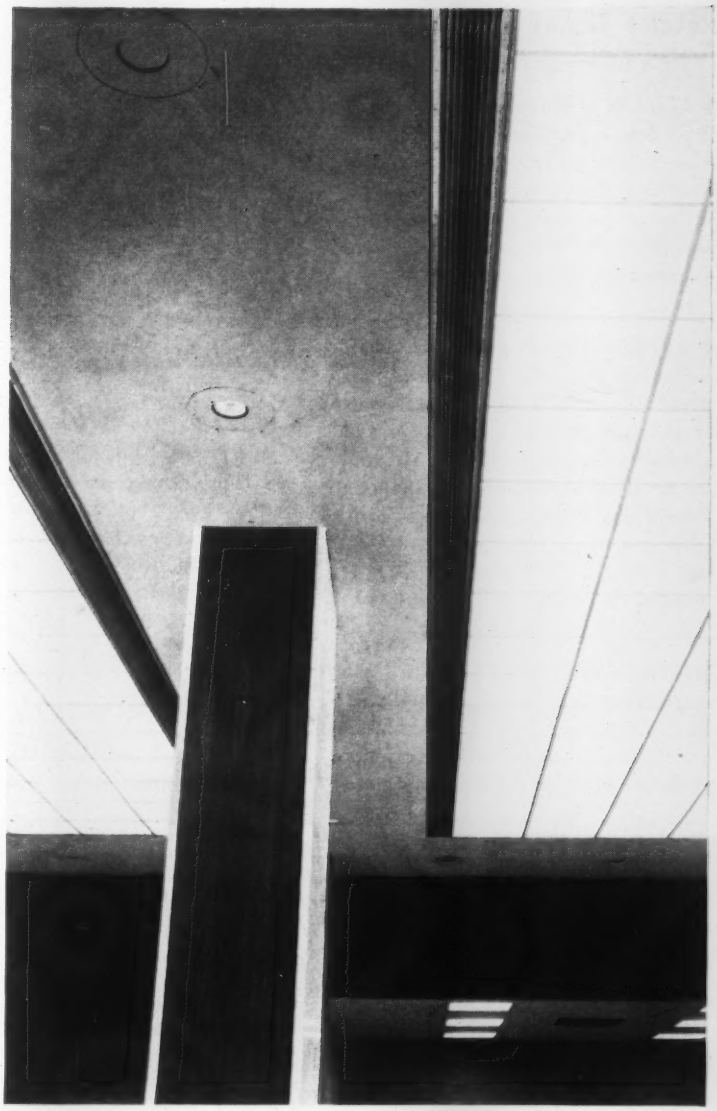
▸ *RADIATOR VALVES, FITTINGS* — for steam, hot water heating, identified in bulletin "225" with illustrations, roughing-in dimensions. *Sarco Co., Inc., 635 Madison Ave., New York 22, N. Y.*

▸ *REFRIGERANT CONTROLS* — including expansion and solenoid valves, regulators, distributors, strainers, level controls, listed in catalog "59A", with specification charts. *Sporlan Valve Co., 7525 Sussex Ave., St. Louis 17, Mo.*

▸ *ROOF EXHAUSTER*—powered by belt drive for reduced-height design; bulletin "60-CK" covers air moving capacities for 141 models, with dimensional and curb mounting drawings, electrical requirements and available accessories. *Jenn-Air Products Co., Inc., 1102 Stadium Dr., Indianapolis 7, Ind.*

▸ *SILENCERS*—for ductwork, ventilators, listed in catalog "160" with manufacturing information, pressure drop tables, reduction and attentuation data. *Elof Hansson, Inc., Acoustical Div., 711 Third Ave., New York 17, N.Y.*

Draftless ANEMOSTAT® Air Diffusers *at* BANKERS TRUST COMPANY



DESIGNER for the Bank: Henry Dreyfuss • ARCHITECTS for the Bank: Shreve, Lamb and Harmon Associates • CONTRACTOR for the building and the Bank: Diesel Construction, Inc. • MECHANICAL ENGINEERS for the Bank: Meyer, Strong and Jones • SUB-CONTRACTORS: Raisler Corporation

In the new offices of the Bankers Trust Company at 529 Fifth Avenue, New York, customers and employees enjoy complete air conditioned comfort with Anemostat Air Diffusers. In the banking area, over 1500 feet of Anemostat Straight Line Air Diffusers draftlessly distribute the conditioned air.

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ANEMOSTAT CORPORATION OF AMERICA

10 East 39th Street, New York 16, N. Y.

Representatives in Principal Cities 1376

RECENT TRADE LITERATURE

Continued

▶ *SLURRY PUMP*—bulletin "1158" describes compressed air unit for flow volume to 180 gph at pressures to 90 psi for metering slurries with up to 60 percent solids. *Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.*

▶ *SPEED REDUCERS*—for shaft mounting on driven machines, for capacities to 170 hp, output speeds from 10 to 400 rpm, in single and double reduction series, 5, 15, and 25 to 1 ratios described in bulletin "A692" with construction details, dimensions, and installation information; illustrated. *Dodge Mfg. Corp., Mishawaka, Ind.*

▶ *STANDBY ELECTRIC PLANTS*—guide to selection and installation gives required items for evaluation for particular needs, with description and specifications for models of gasoline and diesel powered units offered. *D. W. Onan & Sons, Inc., 2515 University Ave., S.E., Minneapolis 14, Minn.*

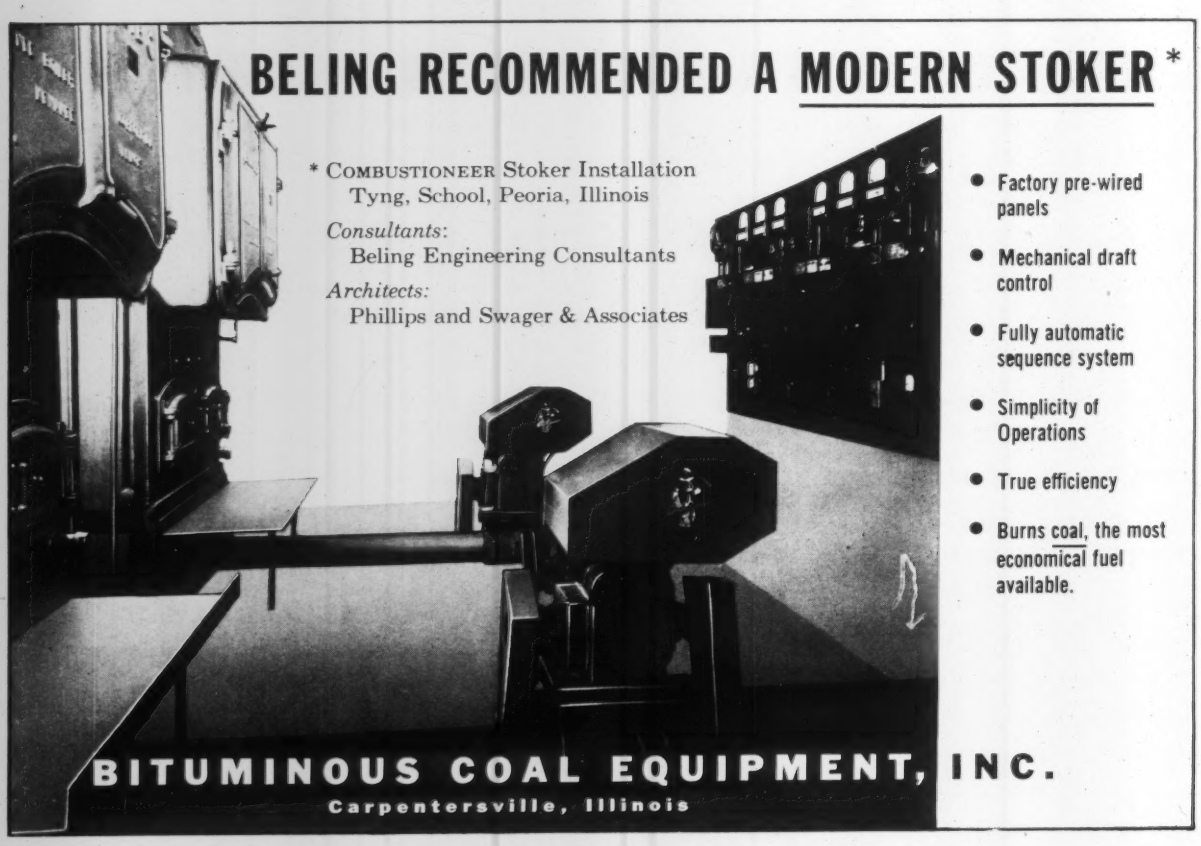
▶ *TEMPERING VALVES*—in 3/4 through 2 in. sizes featured in bulletin with sketches and specifications, plus installation drawings. *Lawler Automatic Controls, Inc., 453 N. MacQuesten Pkwy., Mount Vernon, N.Y.*

▶ *WATER CONDITIONING*—technical reprint "T-178" describes research problems connected with feedwater supply for Eddystone steam power plant; with pilot plant data and discussion of methods for quality measurement. *Graver Water Conditioning Co., 216 W. 14th St., New York 11, N.Y.*

▶ *WATER CONDITIONING*—data sheet discusses problem of internal baffling for pure steam production, with itemization of mechanical and chemical factors involved. Titled "Solving An Unusual Case of Carryover." *Betz Laboratories, Inc., Gillingham and Worth Sts., Philadelphia 24, Pa.*

▶ *WELDING FITTINGS AND FLANGES*—series of 24 data folders, "FDC 252" through "FDC 275" catalog by size, dimensional and physical data line of fittings available. *The Babcock & Wilcox Co., Tubular Products Div., Milwaukee 46, Wis.*

▶ *WELDING PROCESS*—described in booklet "NH-137" with description of equipment and electrodes used; illustrates available welding control and torch, lists types of welding for which process is effective; includes cross sections of butt and fillet welds. *National Cylinder Gas Div., Chemetron Corp., 840 N. Michigan Ave., Chicago 11, Ill.*



how many "tons" can a "horsepower" carry?

Or how many "cubic feet" make a "ton"?

Sooner or later, questions like these will come up when you use such terms to describe the cooling capacity of unitary* air-conditioning equipment. When your prospect starts asking them, his confusion may lose you an important sale.

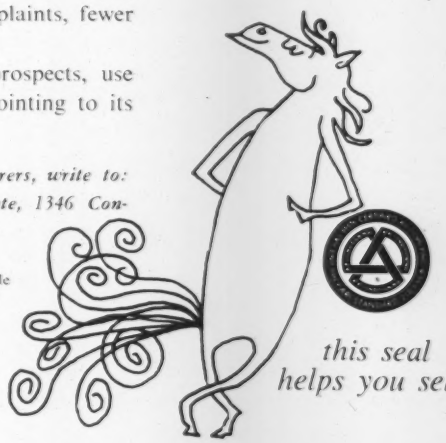
To avoid this, the Unitary Section of the ARI has set up industry-approved standards. Participating manufacturers now rate the cooling capacity of all unitary equipment in Btu per hour. This rated capacity is subject to checking and verification by an independent testing laboratory. A unit, selected at random from a participating manufacturer's stock, is tested under adverse conditions with emphasis on wilting heat and high humidity. Any model failing to deliver rated capacity must be brought up to standard or be withdrawn from sale.

The ARI Seal of Certification assures you of equipment you can count on—equipment that makes it easier for you on any job. It is easier to maintain, too. The dependability of this equipment pays off in fewer complaints, fewer service calls, fewer repairs and replacements, more profits for you.

To avoid confusion when discussing cooling capacity with prospects, use Btu per hour—and *prove* the capacity of your equipment by pointing to its ARI Seal of Certification.

For free explanatory booklet and Directory of participating manufacturers, write to: Chief Engineer, Dept. H-403, Air-Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N.W., Washington, D.C.

*"Unitary" air conditioners included in this program: all packaged air conditioners, whether single units or two-piece units (called "split" systems) up to 135,000 Btu per hour in capacity, but not including room air conditioners. ARI Standard 210-58 for electrically-driven equipment; ARI Standard 250-58 for heat-powered equipment.



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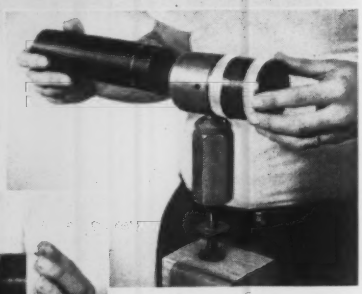
POLYFUSION*

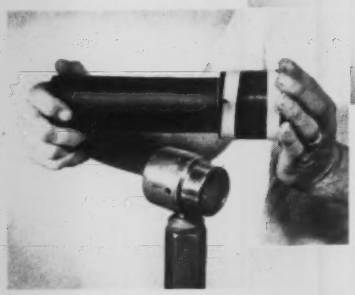
is one more reason

Vulcathene® DRAINLINES

are rugged and unbreakable!



Putting VULCATHENE Pipe and Fitting on Polyfusion Tool.



Joining VULCATHENE Pipe and Fitting by Polyfusion . . . without glue, cement or solvents.

DOUBLE-STRENGTH AT EVERY JOINT

Cutaway of VULCATHENE Pipe and Fitting showing complete fusion of material. *Note that it is impossible to see point of joining.*

If you are handling corrosive or acid materials, VULCATHENE, of *finest grade*, virgin polyethylene, will solve your drainline problems. VULCATHENE is light, easy-to-handle . . . assembles fast, with the polyfusion technique forming permanent, *leak-proof joints.*

Nothing adheres to VULCATHENE. Even after years of service, the inner walls of VULCATHENE are still smooth, assuring fast flow of waste and sludge.

Today, many leading industries are proving VULCATHENE the most practical and economical plumbing yet devised for laboratory and industrial drains.

For literature or technical assistance—Write Dept. F-1

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DIVISION OF THE NALGE CO. INC.

WE HEAR THAT . . .

▶ *THE WHITE FLOMATIC CORP.*, will become a division of the newly formed *FLOMATIC CORP.*

▶ *HOWELL ELECTRIC MOTORS CO.* has acquired the flat type motor line formerly manufactured by the *DIEHL MFG. CO. DIV., SINGER MFG. CO.*

▶ The name of the *H. K. PORTER CO. INC. MOULDINGS DIV.* has been changed to *COLDFORM DIV.*

▶ *THE JOHNS-MANVILLE CORP.* has been elected to membership in the *OIL HEAT INSTITUTE OF AMERICA.*

▶ Several representatives of the Japanese Small Business and Industry Trade Union Team visited the *OCTAGON VENTILATOR CO.* to observe engineering and manufacturing operations during the team's recent tour of this country.

▶ *WAUKESHA MOTOR CO.* has moved its Los Angeles branch quarters to 5608 Soto St., Huntington Park, Calif.

▶ *MASTER POWER CORP.*, subsidiary of *THE BLACK & DECKER MFG. CO.*, will build a 50,400 sq ft factory and office building in Solon, O.

▶ *ALUMINUM CO. OF AMERICA* has announced plans to double its capacity for the production of enamel-coated aluminum sheets.

▶ *NATIONAL-U.S. RADIATOR CORP.*, newly acquired by *CRANE CO.*, will operate under the new name of *NATUS CORP.*

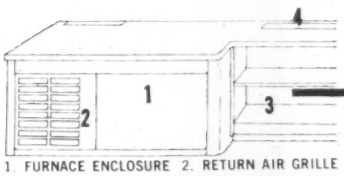
▶ *ASSOCIATED LABORATORIES, INC.*, newly formed national group for the furtherance of industrial water treatment services, held its first meeting recently in Atlanta, Ga.

▶ *THE CENTURY ELECTRIC CORP.* has reorganized its national sales operation into six major divisions: Northeast, Southwest, Midwest, North Central, Southeast, and Western divisions.

a study in economy

The Norman economy story begins right with the installation of the individual gas-fired **Norman Schoolroom Heating and Ventilating Systems.** There's no need for expensive boiler rooms, stacks, pipe tunnels, boilers, control panels, circulating pumps or expansion tanks. Each Norman forced warm-air system adds another chapter in economy . . . there's no need to re-vamp a central system when the school grows! Room by room Norman Systems automatically provide heat rapidly and supply the proper blend of outdoor air and recirculated room air for cooling and ventilation. The low operating and maintenance costs make the Norman economy story one without ending.

Write Today for New 1960 Comprehensive Manual
See folder in 1960 Sweets Arch. File 31h/No



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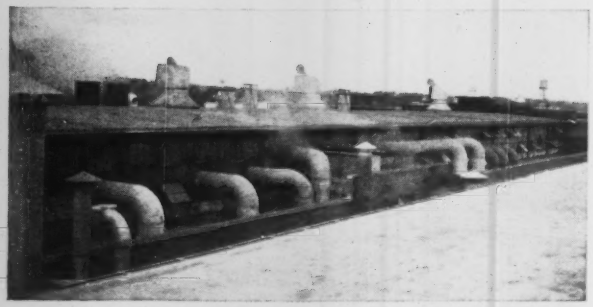
3. UTIL-I-DUCT® BOOKSHELF 4. AIR DIFFUSER

Norman®
PRODUCTS CO. • 1156 Chesapeake Ave. Columbus 12, Ohio

the downturn



and upturn at KVP

Same picture – different setting. Top shows complicated, space-wasting duct system which routed fumes back into plant for discharge through stacks. Bottom shows nine new 36" Aerovent "SP-7" Duct Fans installed to take fumes *up* and *out*, saving valuable floor space in busy working area. Just one of hundreds of successful Aerovent installations characterizing modern air engineering in action.

Write for free BULLETIN 400

All Aerovent Fans are rated in accordance with the Standard Test Code and U S D C Comm. Std. CS178-51.

Certified Ratings

Aerovent FANS

Aerovent

FAN COMPANY, INC.

ASH and BRANCH STS. • PIQUA, OHIO

Member Air-Moving and Conditioning Assn. (AMCA)

WE HEAR THAT

Continued

▸ *RAYPAK CO., INC.*, has announced it will enter the hydronic cooling field in 1960.

▸ *THE AMERICAN GAS ASSOCIATION* reports that Dec. 1959 sales by gas utility and pipeline industries rose 6.2 percent over the similar period in 1958.

▸ *WELBILT AIR CONDITIONING AND HEATING CORP.*, a subsidiary of *WELBILT CORP.*, will establish a national network of franchised dealers and distributors soon.

▸ *CARRIER CORP.* has announced that the 5000th centrifugal refrigeration machine produced by that company will be installed in the terminal building of the new Dulles International Airport, Washington, D.C.

▸ *THE BABCOCK & WILCOX CO., BOILER DIV.* has opened a district sales and service office in Denver, Colo., to serve the Mountain States area.

▸ The former Chicago real estate partnership *ALDIS & CO.*, of which HP&AC Board of Consulting and Contributing Editors member R. E. Hieronymus is a principal, has incorporated under the name of *ALDIS & CO., INC.*

▸ *SWARTWOUT FABRICATORS, INC.*, has begun production in its newly acquired plant in Kokomo, Ind.

▸ Shareholders of *THE DAYTON RUBBER CO.* have voted to change the corporate name to *THE DAYCO CORP.*

▸ *FRED S. DUBIN ASSOCIATES, Consulting Engineers*, has moved its New York office to new quarters at 7 East 47th St., New York, N.Y.

▸ *FIBROUS GLASS PRODUCTS, INC.*, a subsidiary of *PALL CORP.*, has purchased land for the construction of offices, manufacturing, and warehousing facilities in Syosset, L.I., N.Y.

▸ C. Louis Meyer, Chicago, has been named the Outstanding Young Salesman for 1959 by *AMERICAN AIR FILTER CO.*, and will receive the Robt. W. Nelson Memorial Award.

WHO'S WHAT . . .

(new personnel, promotions)

▸ *GENERAL CONTROLS CO.*—George Crothers, vice president and general manager, Canadian Div.

▸ *J. E. LONERGAN CO.*—Norman J. Smith, chief engineer.

▸ *THE ROBERT IRSAY CO.*—James H. Stiggleman, vice president.

▸ *BOWMAN STEEL CORP.*—Jack Gore, assistant sales manager, ventilators.

▸ *COMPRESSED GAS ASSOCIATION INC.*—president: George C. Cusack, executive vice president, Pure Carbonic Co.

▸ *FRED S. DUBIN ASSOCIATES, Consulting Engineers*—A. Roger Kelly, P.E., associate and New York office manager.

▸ *FURNAS ELECTRIC CO.*—William Few, general manager of manufacturing; Dale F. Willcox, chief engineer.

▸ *MIDWEST PIPING CO., INC.*—Warren Smith, assistant director of manufacturing sales.

▸ *CINCINNATI MECHANICAL CONTRACTORS ASSOCIATION*—Vincent Hotze, Hotze Heating Co., Cincinnati, president.

▸ *WATTS REGULATOR CO.*—Robert J. Tesar, sales manager.

▸ *BLACK, SIVALLS & BRYSON, INC.*—Edward W. Reif, sales manager, controls division.

▸ *JAMESBURY CORP.*—LeBurton D. Webster, controller.

▸ *THE LAU BLOWER CO.*—S. F. Hipple, vice president for operations; William H. Wentling, director of engineering; Harold F. Farquhar, chief engineer.

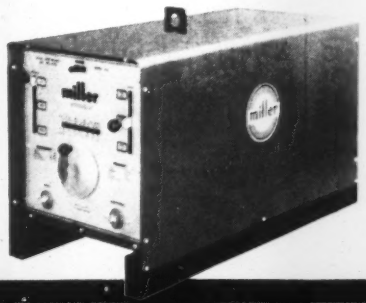
▸ *CONTROLS CO. OF AMERICA*—Harold F. Ames, vice president and director of sales, control switch division.

▸ *H. K. PORTER CO.*—Fred W. Elliott, James A. Drain, Emmett H. Mann, B. Campbell Blake, group vice presidents; Charles R. Billman, general manager, National Electric Div.

▸ *CHASE BRASS & COPPER CO.*—Herman H. Kremer, vice president in charge of sales and director; Paul M. Thomas, general sales manager; Walter E. Evans, assistant to the president.

miller WELDERS

BIG TWIN
250 AC/DC



LITTLE TWIN
180 AC/DC

AND BOTH MILLERS . . . *Through and Through*

BIG TWIN combination ac-dc welders work from single phase service — deliver new convenience and economy. Two a-c amperage ranges of 20-125 and 60-290 plus two d-c ranges of 18-100 and 65-290 amps master nearly every welding requirement from light gauge metal to structural pieces. Movable shunt type transformer affords infinite current adjustments. Other features include: Horizontal design for easy stacking; weather-resistant construction and Class B insulation; Miller-built semi-metallic rectifier for best d-c welding; high open circuit voltages and new weld stabilizer. This is THE all-time, all-around welder!

LITTLE TWIN ac-dc combination welder has two a-c amperage ranges of 20-115 and 60-180 plus one d-c range of 40-150. Operating from single phase service, this Miller model incorporates many design and construction features usually found only in large industrial types. These include really rugged construction, forced air cooling, new Miller semi-metallic rectifier, movable shunt type current control, new weld stabilizer and open circuit voltage in abundance. Power factor correction is available on both models. Complete specifications on either model will be sent promptly upon request.

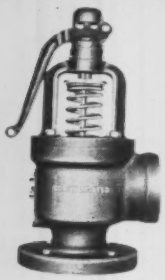
miller ELECTRIC MANUFACTURING COMPANY, INC., APPLETON, WISCONSIN

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

Heating and Air Conditioning

OVERPRESSURE CONTROL

CONSOLIDATED SAFETY VALVES GIVE POSITIVE *PROTECTION*



Type 1511 Safety Valve. Cast iron body. Maximum capacity for saturated steam. Sizes: 1½" through 6". Pressures to 250 psi. Temperatures to 450°F.

Make certain steam, air and gas pressures are held within safe limits on your heating, piping, and air conditioning projects. Consolidated Safety Valves automatically relieve overpressures in everything from package-type boilers and large steam generators to air tanks and other unfired pressure vessels. A 2100-pound design boiler is used to test and set these valves—to guarantee capacities and assure the best protection. Typical plus values of Consolidated Safety Valves are exemplified in the Type 1511:

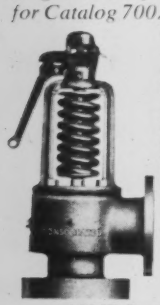
Compactness saves space and headroom; permits the use of smaller, more economical discharge piping.

Lower Cost per pound of steam discharged because maximum capacity is designed into minimum flange size. Fewer or smaller safety valves can be used on a boiler.

Better Alignment through double-guided adjusting ring and disc guide assures easier, more uniform blowdown adjustment and control, and finer operation.

Positive Tightness is created because the seat is machine-lapped to optical flatness.

On large or small installations, spring-loaded Consolidated Safety Valves give positive protection to personnel and facilities. Whatever the working pressures and temperatures of your heating, piping and air conditioning projects, choose Consolidated. Precision-made with few working parts, they are tough, long-life safety valves that rarely require maintenance. *Write for Catalog 700A.*



Type 1415 Safety Valve. Cast steel body. High capacity for saturated and superheated steam. Sizes: ½" through 6". Pressures to 900 psi. Temperatures to 900°F.

Type 1551 Safety Valve. Bronze body. For steam, air, gas. Sizes: ⅜" through 3". Pressures to 300 psi. Temperatures to 450°F.

ASME Standard • ASME Tested • National Board Certified

MAXWELL MANNING MM&M TRADE MARK

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

WHO'S WHAT

Continued

▸ *UNION CARBIDE CORP., NATIONAL CARBON CO. DIV.*—J. R. Johnstone, assistant to the president; Fred B. O'Mara, director of manufacturing.

▸ *WILLIAM WALLACE CO.*—Donald G. Harmon, general manager, Standard Lines Div.

▸ *SCHAEVITZ ENGINEERING*—Alan H. Master and Bertram J. Burck, assistants to the president.

▸ *REFRIGERATION & AIR CONDITIONING CONTRACTORS ASSOCIATION OF NEW JERSEY*—Saul Marder, president; Ray L. Eggert, Jr., vice president; Chester J. Karas, secretary-treasurer; William J. Capo, sergeant-at-arms; J. Lloyd Handy, executive secretary.

▸ *BOHN ALUMINUM & BRASS CORP.*—Allan R. Poore, director of industrial relations.

▸ *NATIONAL INDUSTRIAL CONFERENCE BOARD*—Roy C. Ingersoll, chairman of the board, Borg-Warner Corp., member.

▸ *PALL CORP.*—Dr. Mathias P. L. Siebel, general manager, Pressure Equipment Div.

▸ *PITTSBURGH PLATE GLASS CO.*—Ralph S. Michael, Jr., manager, industrial finishes, Paint Div.

▸ *AMERICAN TUBE PRODUCTS, INC.*—Nicholas R. Foloky, director of engineering.

▸ *WARMINSTER FIBERGLASS CO.*—Richard D. Paynton, sales manager.

▸ *FEDERAL BOILER CO.*—Paul O. Bergeron, sales manager.

▸ *REFRIGERATION AND AIR CONDITIONING CONTRACTORS OF CHICAGO*—president: Daniel M. Brown, Systems Engineering Corp.; vice president: Harvey O. Miller, Murphy & Miller, Inc.; secretary-treasurer: Oliver P. Crose, The Crose Co.

▸ *BORG-WARNER CORP.*—J. M. L. Joslin, manager, executive development and training.

WHO'S WHAT

Continued

▶ *THE TRANE CO.*—Milton L. Hoglund, manager of refrigeration applications engineering; Wesley W. Wright, manager of centrifugal compressor sales; Donald F. Spirduso, assistant advertising manager.

▶ *THE DAYTON RUBBER CO.* L. J. Keyes, vice president and director of purchases.

▶ *CRANE CO.*—T. B. Focke, vice president, Plumbing-Heating-Air Conditioning Group; C. H. Lovelace, vice president, Industrial Products Group; Alvin R. Storch, Jr., manager, engineering sales.

▶ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—James S. Locke and Wesley R. Moore, vice presidents; Carl Boyer Jr., chief engineer, Rubicon Instruments Div.

▶ *WORTHINGTON CORP.* W. C. Check, H. W. King, W. J. Van Vleck, commercial vice presidents.

▶ *THE BETTER HEATING-COOLING COUNCIL.*—Henry M. Gibb, commercial and industrial division plans board chairman; Douglas Grewer, manager, commercial and industrial division.

▶ *KEYSTONE BRASS WORKS*—George F. Dublin, general manager.

▶ *WARREN WEBSTER & CO., INC.* Irving G. Brennan, product sales manager, air conditioning.

▶ *DUNKIRK RADIATOR CORP.*—James R. Cassidy, sales manager.

▶ *HORACE T. POTTS CO.*—Donald C. Taylor, assistant to the president; John W. Beckard, vice president, sales and manufacturing; John A. Stringer, vice president, finance and purchasing; William C. Spencer Jr., director of purchases; George A. Parker Jr., sales manager.

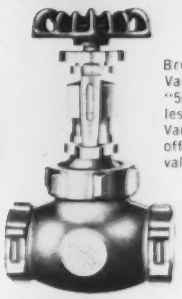
▶ *AIRTEMP DIV., CHRYSLER CORP.* Henley M. Hillburn, business and market research manager; Arthur L. Foster, advertising manager.

▶ *NATIONAL FUELOIL COUNCIL.*—J. L. Minner, chairman of the board; William F. Kenny Jr., vice chairman.

Heating and Air Conditioning

FLOW CONTROL

HANCOCK VALVES DO THE JOB *ECONOMICALLY*



Bronze "Flocontrol" Valves. ¼" thru 2". "500 Brinnell" stainless steel V-port disc. Variable orifice, shut-off and index in one valve.

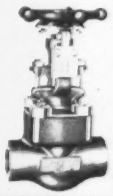
Reliable control of flow contributes substantially to complete owner satisfaction with every heating, piping, and air conditioning system you install.

Whether the application demands pin-point control of flow or full flow, Hancock Valve performance proves there is no substitute for the economy of quality. Highest operational perfection is combined with lowest maintenance. Whatever the piped medium – fuel oil, gas, water, or steam – the quality of Hancock Valves helps assure uninterrupted service. Typical advantages of Hancock Bronze and Steel Valves are:

RUGGEDNESS that continues to ward off the deteriorating effects of wire drawing, galling, steam cutting, erosion and corrosion long after ordinary valves fail.

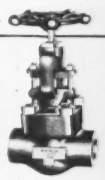
MAINTENANCE ECONOMY because carefully selected materials are precision-formed into functional parts of long-lasting efficiency. Servicing can be done in the line. Standardization of components means inventory economy.

Learn all the job-proved reasons why Hancock Valves are today's best buy in terms of your standard of reliability. Globe, Angle, Gate, and "Flocontrol" types available with application characteristics suited to your heating, piping, and air conditioning requirements. *Write for Catalog 200A.*

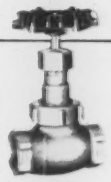


Steel "Flocontrol" Valves. ¼" thru 2". V-port disc compels proportional flow throughout the lift of the stem.

600# Steel Gate Valves. ¼" thru 2". Forged steel body. Maximum use of stainless steel.



600# Steel Valves. Globe and Angle. ¼" thru 2". Forged steel body. "500 Brinnell" stainless steel disc.



Bronze Valves. Globe and Angle. ¼" thru 2". "500 Brinnell" stainless steel seat and disc. 125% to 230% stronger diaphragm.

MANNING MAXWELL & MOORE TRADE MARK

HANCOCK VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

WHO'S WHAT

Continued

▶ *THE WIREMOLD CO.*—Robert S. Dutton, assistant sales manager, air duct division.

▶ *ALLIS-CHALMERS MFG. CO.*—D. B. Scott, manager, control department; Robert C. Bowen, manager, rectifier section.

▶ *BONNEY FORGE AND TOOL WORKS*—George D. Fritch, vice president; William M. Jackson, vice president and manager, Bonney Forge Div.; Richard R. Holstrom, vice president and manager, Tool Div.; George A. Hart, vice president and general sales manager.

▶ *VEECO VACUUM CORP.*—William R. Meoli, vice president and sales manager.

▶ *KIELEY & MUELLER, INC.*—Richard A. Cummings, works manager, production.

▶ *AMERICAN STANDARD INDUSTRIAL DIV.* Donald S. Selbe, manager, quality control, Buffalo-Walden plant; Gordon Parrington, superintendent, Dearborn plant.

▶ *WATER SERVICE LABORATORIES, INC.*—William F. Devenney, engineering staff, Philadelphia office.

▶ *CARRIER CORP.*—Leon Hutton and Samuel Shawhan, vice presidents.

▶ *EVERLASTING VALVE CO.*—William Harrower, chairman of the board; George Zimmerman, sales vice president and director.

▶ *DOLLINGER CORP.*—John J. Hart, chief engineer; E. Grant Pike, research director.

▶ *THE POWERS REGULATOR CO.* James Tobin, national installation and service manager.

▶ *LENNOX INDUSTRIES, INC.*—Roger C. Lakey, director of marketing services; A. C. Stentz, manager, Columbus plant.

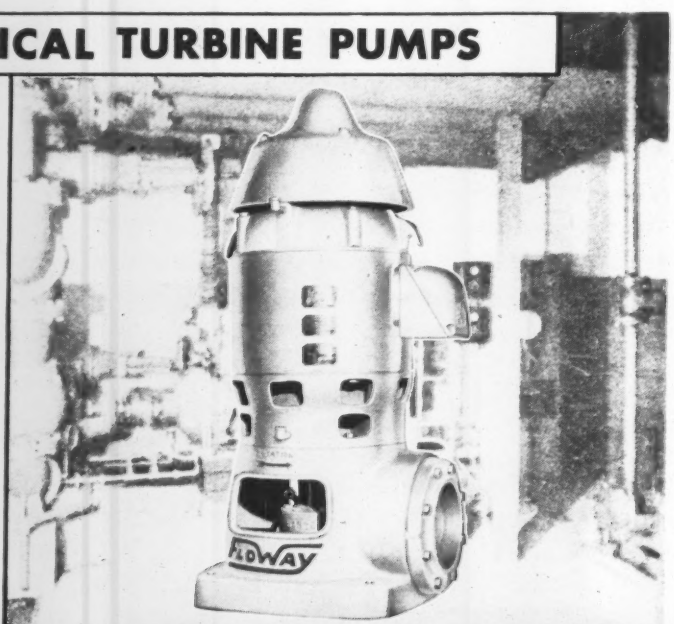
▶ *JOSEPH T. RYERSON & SON, INC.* Harold J. LeBeck, assistant manager, industrial plastics and bearings div.; Wallace E. Felldin, sales manager, New York plant.

FLOWAY
formerly SMITHway

VERTICAL TURBINE PUMPS

How Much is Floor Space Worth?

Plant floor space, figured on a per square foot basis, is always valuable, always expensive, often critical. If FloWay Vertical Pumps had no other outstanding features to recommend them, they would merit your investigation on the score of space-saving alone. But the advantages of FloWay's advanced design, rugged construction, and versatility overshadow even this important feature for economical industrial pumping. Send for Bulletin #14 describing FloWay's full line of vertical pumps.



Contact your FloWay distributor

Oakland, California — Pacific Pumping Company
San Francisco, California — Woodin & Little
Denver, Colorado — Harry J. Glass & Associates
Oakland Park, Florida — Peninsular Armature Works
Metarie, Louisiana — A. G. Kirkwood Co.
Baltimore, Maryland — R. Thum & Company
Buffalo, New York — Ralph Simmons & Company
New York, New York — Frank A. Kristal
Cleveland, Ohio — W. J. Bryson Company
Tulsa, Oklahoma — The Kase Company
Portland, Oregon — Pacific Pumping Company
Ardmore, Pennsylvania — Weinman Pump Manufacturing Co.
Pittsburgh, Pennsylvania — Weinman Pump & Supply Co.
Dallas, Texas — Livingston Machinery Co.
Houston, Texas — Pump & Power Engineering Co.
Seattle, Washington — Pacific Pumping Company

FLOWAY Pumps
MANUFACTURED BY
FIESE & FIRSTENBERGER MFG., Inc.
2494 Railroad Ave. Fresno, Calif.

IN THE TERRITORIES . . .

(Recent sales appointments)

▶ *CLEAVER-BROOKS CO.*—Dyke & Associates, Inc., and Heat Exchange Products Co., sales agencies for southeastern Wisconsin, and northern Wisconsin-upper Michigan, respectively.

▶ *FARRIS ENGINEERING CORP.*—C. L. Boyer & Co. field sales representatives, Billings, Montana.

▶ *LIMA REGISTER CO.*—Fred E. Bayless, district manager for New Jersey, Pennsylvania, Maryland, Delaware, and District of Columbia.

▶ *CAMLOC FASTENER CORP.*—Bennet F. Becker, eastern sales manager.

▶ *GENERAL ELECTRIC CO.*—Martin J. Lewis, manager, central air conditioning sales, New Orleans district.

▶ *WOLVERINE TUBE DIV., CALUMET & HECLA, INC.*—Gordon R. Jobe, sales representative, Dallas; John E. O'Connor, heat transfer specialist, Cleveland; John H. Roehm, sales representative, Cleveland; George K. Ommundsen, sales representative, Washington, D.C.

▶ *S. S. WHITE CO., PLASTICS DIV.*—Blumberg Supply Corp., Hempstead, L.I., N.Y., sole distributor for plastic caps, plugs, and protective closures.

▶ *MODINE MFG. CO.*—F. R. Young Co., Mechanical Engineers, sales representatives, Houston, Texas.

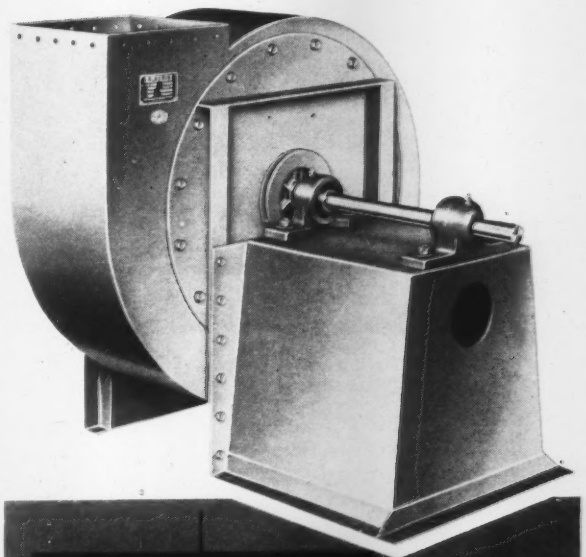
▶ *MUELLER CLIMATROL*—Donald W. Irwin, sales representative, Michigan area; Robert Wenke, regional manager for distributor sales.

▶ *POWERS REGULATOR CO.*—Andrew H. Millar, branch office manager, Winnipeg, Manitoba, Canada; J. L. Fitzgerald, sales manager for non-installed products, Western div.; Don R. Bachman, district manager, San Francisco.

▶ *HAYS MFG. CO.*—David D. Ackerman, sales representative, metropolitan New York.

▶ *ARMSTRONG FURNACE CO.*—James H. Buchwald, district manager, Iowa.

Aladdin
AIR HANDLING EQUIPMENT



TYPE "EX" INDUSTRIAL EXHAUSTER

- RUGGED
- EFFICIENT
- DEPENDABLE

ALADDIN Industrial Exhaust Fans are all-welded steel plate construction. They are ideal for material handling such as conveying grains, shavings and sawdust, or for dust removal from grinding of buffing wheels. The EX fan is also the first choice for many jobs where fumes, hot air or gasses must be handled by a rugged, efficient, dependable fan.

Write for complete data

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

WHO'S WHAT

Continued

▶ *C. G. HUSSEY & CO.*—W. B. Blakesley, assistant district manager, Cleveland.

▶ *THE MARLEY CO.*—Hubert J. Bierman, regional manager, north-central area, Chicago-based.

▶ *MARSH INSTRUMENT CO.*—Harold H. Mitchler, district manager, metropolitan New York.

▶ *MORRISON PRODUCTS, INC.*—John E. Petersen, sales and distribution supervisor, Chicago and Cook County, Ill.; Arthur E. Duwe, sales representative, Wisconsin.

▶ *THE BABCOCK & WILCOX CO.*—Robert L. Swinney, district sales manager, Denver.

▶ *THE DEMING CO.*—sales representatives as follows: Frank J. Canale, Louisiana, Mississippi, Alabama and western Florida; Robert G. Milliken, Washington, Oregon, Idaho, Wyoming; Grant B. Roman, Arkansas, Oklahoma, Texas Panhandle; Paul D. Hill, Jr., New York and western Vermont.

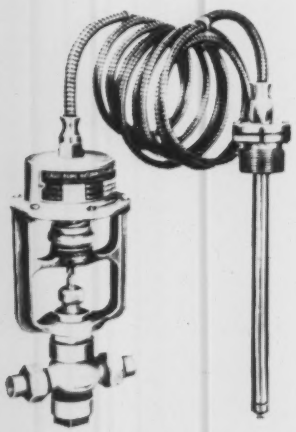
▶ *BOHN ALUMINUM & BRASS CORP., DANVILLE DIV.*—Krenz and Co., sales representative, eastern Wisconsin; Keatts Thermal Equipment Co., sales representative, central Ohio; Allan K. Cook Co., sales representative, Kentucky and southern Indiana; Gygax Engineering & Equipment Co., sales representative, eastern Missouri and southern Illinois; Bartholomaus Enterprises, Inc., sales representative, metropolitan New York and surrounding counties; Sharpe Heating & Ventilating, Inc., sales representative, southern California; T. A. Heidenreich Co., Inc., sales representative, central Indiana.

▶ *JOSEPH T. RYERSON & SON, INC.*—Carl C. Gobdel, district sales manager, Philadelphia.

▶ *BARBER MFG. CO.*—the following appointed manufacturer's representatives: Industrial Combustion Sales, New York State less New York City, and northern Pennsylvania; Edwin P. Cook Co., Colorado, New Mexico, Arizona, Utah, Nevada, Wyoming; Hugh J. McGlinchey Associates, eastern Pennsylvania, southern New Jersey, Maryland, Delaware; The Sales Engineers, Minnesota, North and South Dakota, Iowa, Nebraska.

▶ *AMERICAN TUBE PRODUCTS, INC.*—Fred Ehers, regional sales manager, New Jersey.

TC
TEMPERATURE REGULATOR



KEEPS THE LID ON *RUNAWAY* TEMPERATURES

When sudden temperature changes can spell trouble in modern processing and heating-cooling applications, specify TC Temperature Regulators.

Utilizing a highly sensitive, vapor-pressure sensing element, TC Temperature Regulators immediately go into action upon the slightest temperature variation. Instantly, the ruggedly built bellows operated valve assembly corrects to and maintains the desired temperature.

Use TC Temperature Regulators for constant accurate control of steam, water, gases . . . any heating or cooling fluid requiring vital temperature control.

A. W. CASH VALVE MFG. CORP.
Decatur, Ill.

CASH AUTOMATIC VALVES ACME

INDUSTRY'S WIDE, WIDE LINE

WHO'S WHAT

Continued

▸ *PEERLESS MFG. DIV., DOVER CORP.*—C. R. Hayes, Donald T. Back, Robert Dean, sales representatives in metropolitan St. Louis, and Ohio, and Alabama-Columbus, Ga.-Pensacola, Fla., respectively.

▸ *TORRINGTON MFG. CO.*—Merrill B. Hunting and Ira J. Roy, field sales representatives, Chicago.

▸ *A. M. BYERS CO.*—new distributors: Hajoca Corp., Trenton, N. J.; Mountain States Pipe and Supply Co., Colorado Springs; Astubeco, Inc., New York.

▸ *REZNOR MFG. CO.*—J. William O'Brien, district sales manager, Pennsylvania and northern West Virginia.

▸ *AMERICAN AIR FILTER CO., INC.*—Russel C. Taylor, Pacific regional manager; Charles J. Bressoud, manager, Los Angeles branch office.

▸ *CONNOR ENGINEERING CORP.*—Airfoil Products Corp., sales representative for northern Illinois, northwestern Indiana, and Wisconsin.

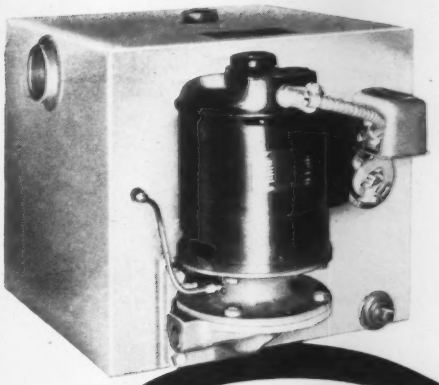
▸ *DELAVAN MFG. CO.*—Lemarco Agricultural Spraying and Machinery Co., manufacturer's representative in Central and South America.

▸ *THATCHER FURNACE CO.*—William P. Coker, representative in North and South Carolina.

▸ *ILG ELECTRIC VENTILATING CO.*—Northwest Equipment Supply Co., sales representative for Minnesota, North and South Dakota, northwestern Wisconsin and Michigan; J. W. Hamrick, Jr., branch manager, Jackson, Miss.; Bert Burney and Associates, Inc., sales representative, Omaha.

▸ *COPELAND REFRIGERATOR CORP.*—Dale H. Bodine, manager, Ohio, Kentucky, central and south Indiana, western West Virginia, western Pennsylvania region; Donald R. Macklem, manager, Texas, Oklahoma, western Louisiana region; A. S. Garven, manager, New England states, northern New Jersey, and metropolitan New York; Dennis J. Miller, manager, Nebraska, Iowa, southern Wisconsin, northern Illinois and northwestern Indiana; E. L. Johnson, associate manager, pacific northwest and northern midwest states.

▸ *VILTER MFG. CO.*—Jack Deroche, sales representative, Milwaukee and Madison, Wis., areas.



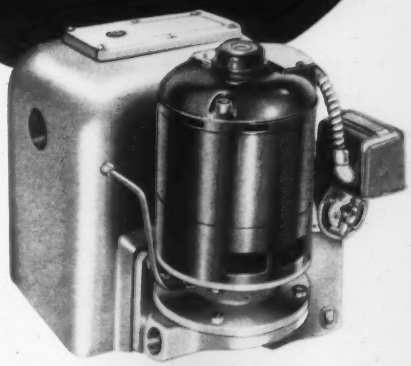
4100 Series STEEL TANK

Efficient in operation . . . neat and compact in design. Easy to service . . . all principal parts — motor, pump, float switch, drain plug — at front of tank.

Sterlco®

low pressure condensate pumps

CAPACITIES: 2000 TO 15,000 SQ. FT. E.D.R.

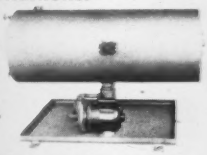


4200 Series CAST IRON TANK

Exactly the same design and performance as the 4100 series, except for cast iron tank where necessary or desirable.

Sterlco pumps are specially engineered . . . they are not adaptions of industrial or water supply pumps. Both series can deliver full rated output continuously, for long periods. Efficient impeller design prevents serious overloading of motors under any conditions.

SPECIAL APPLICATIONS — *For boiler return systems, greater capacities, or higher pressures, the 3500 series is available. It can be built to handle any job.*



Ask your plumbing and heating distributor, or write us for complete information!

Leaders in temperature controls since 1916

Sterling inc.

5208 West Clinton Avenue Milwaukee 23, Wis.

WHO'S WHAT

Continued

▸ *HUPP CORP., PERFECTION DIV.*—W. H. Westenhoefer, James C. Hackley, and Alvin J. Schnur, district sales managers for Pennsylvania-New Jersey, Texas-Oklahoma-Louisiana, and Missouri-Kansas-Iowa-Nebraska, respectively.

▸ *AIR CONTROL PRODUCTS, INC.*—Oliver Dean, field sales representative, northern Illinois and southeastern Wisconsin.

▸ *AIRTEMP DIV., CHRYSLER CORP.*—Del Robson, district manager, Kansas City area.

▸ *STODDARD INDUSTRIES, INC.*—Lin Krause, district representative, Minnesota and western Wisconsin.

▸ *PENN CONTROLS, INC.*—Gordon L. Manista, application engineer, Cleveland.

▸ *TENNEY ENGINEERING, INC.*—H. P. Peterson, sales engineer, Refrigeration, Heating, and Air Conditioning Products Div.

▸ *CURTIS MFG. CO.*—Clyde E. Malone, district manager, Chicago Div.

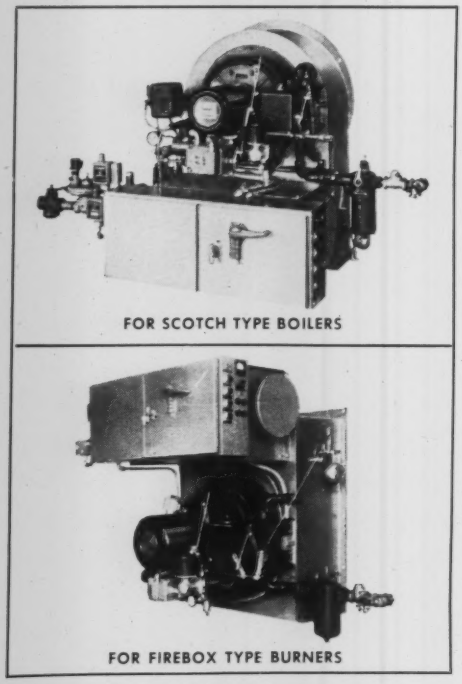
▸ *OHIO BRASS CO.*—Frederick H. Wilson, Jr., district manager, valve sales department, New York.

▸ *J. E. LONERGAN CO.*—Fluid Controls Co., sales representative for Philadelphia, South Jersey, and Virginia territories.

▸ *HUPP CORP., TYPHOON AIR CONDITIONING DIV.*—Dick Southworth, manager, Los Angeles branch.

▸ *THE TRANE CO.*—Robert A. McKee, manager, Albuquerque sales; William G. Barnard, manager, Des Moines sales office; Thomas Shimanski, manager, Madison and La Crosse, Wis., sales offices; Gene J. Lemanski, manager, Aurora, Ill., sales office; Robert R. Trochuck, sales engineer, Chicago; William F. Foster, sales representative, Phoenix; Howell E. Adams, Jr., sales representative, Atlanta, Ga.

▸ *AMERICAN CRUCIBLE PRODUCTS CO., KENCO PUMP DIV.*—Jack Rich Associates, sales representative, Texas and Oklahoma.



FOR SCOTCH TYPE BOILERS

FOR FIREBOX TYPE BURNERS

For Smooth, Efficient Combustion regardless of Stack Conditions and Firebox Pressures!

JOHNSON

FORCED DRAFT *Package-Unit* BURNERS

These quiet, smooth-running compact units come to you completely assembled, tested and wired at the factory . . . ready for easy, inexpensive attachment to any boiler or heat receiver. They give you top performance and minimum fuel costs on any heavy-duty heating installation.

They are built for firing on Oil Only . . . Gas Only . . . and for Combination Oil or Gas Firing. And they are available for either Scotch Type or Firebox Type Boilers as illustrated here.

These efficient units are powered by the time-tested, world-famous Johnson Model 53 Burners which *maintain a fixed air-fuel-ratio regardless of variations in oil temperature and viscosity.* Nine sizes are available ranging from 28 to 560 HP. Whatever your need, there's a Johnson Forced Draft Burner that will fill it efficiently.

Johnson Oil Burners

Builders of fine Oil Burner Equipment since 1903

S. T. JOHNSON CO.
940 Arlington Ave., Oakland 8, Calif.
Church Road, Bridgeport, Pennsylvania

WHO'S WHAT

Continued

▸ *ELGEN MFG. CORP.*—Burt B. Vickery Co., and Ray Meroney Manufacturer's Agency, representatives in Charlotte, N.C., and Atlanta, Ga., respectively.

▸ *LENNOX INDUSTRIES, INC.*—Donald O. Moore, assistant market manager, national accounts; Ted Gilles, commercial market engineer, San Francisco.

▸ *DUNHAM-BUSH, INC.*—David Gardner and Donald Smith, sales engineers in San Francisco and Boston, respectively; William W. Cross, sales engineer, Seattle.

▸ *BROWN FINTUBE CO.*—Thermal Engineering Co., sales representative, Oklahoma, Kansas, Nebraska, western Missouri.

▸ *DELAVAN MFG. CO.*—Gilbert H. Tate, sales engineer, Michigan, Illinois, Wisconsin, northern Ohio, northern Indiana.

▸ *ACME INDUSTRIES, INC.*—Stromquist & Co., and Bound-Rivest Co., sales representatives in Atlanta and Indianapolis, respectively; James G. Coleman, representative in Memphis area; Jack F. Spears, sales engineer, southern Florida; Harry J. Morton and W. Allan Gardner, sales engineers, New York City and Buffalo, respectively.

▸ *HYDROTHERM, INC.*—Robert E. Sullivan, sales representative, northwest Ohio.

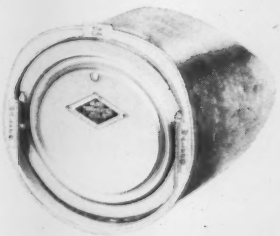
▸ *HENRY VALVE CO.*—Carl J. Bomanz, field engineer, Chicago area.

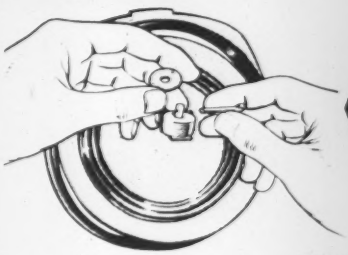
▸ *SLANT FIN RADIATOR CORP.*—Howard Berman, Jack Robinson, and Mike Lavagnino, representatives for metropolitan New York; Frank Jenkins, northern Wisconsin; E. Lloyd Widner, eastern Tennessee.

▸ *TUBE TURNS DIV., CHEMETRON CORP.*—following manufacturer's representatives appointed; Production & Refining Equipment Co., Inc., Odessa, Texas; Epperson & Co., Tampa, Fla.; Moore Dry Kiln Co., Jacksonville, Fla.; Columbus Iron Works Co., Columbus, Ga.; Crane & Ordway Co., St. Paul, Minn.

▸ *RECOLD CORP.*—Hess, Greiner & Polland Co., sales representative for northern California and northwest Nevada.

IMPROVED *Pre-Balanced* draft regulator





...with NEW "Pick-off" vane adjustment!

WALKER 34 (Balanced) DRAFT REGULATOR

• Even more sensitive and dependable than its famous forerunner, the Type 34, this *improved* model, WALKER BALANCED TYPE 34, is *pre*-balanced — *at the factory* — for perfect sensitivity to draft variations. And the BALANCED 34 *stays* balanced — *permanently!*

The new *"Pick-Off" Draft Adjustment* makes precision setting of the BALANCED 34 as easy as picking up a stack of coins! Just pull out cotter pin (above) and add or remove as many pick-off counterweight discs as needed to set the BALANCED 34 exactly for particular draft conditions. *No moving parts to corrode or jam, so unit is always easy to adjust. The WALKER BALANCED TYPE 34 gives you finer, foulproof adjustment to closer limits over a wider range!*

The BALANCED 34 also boasts handsome, newly designed frame, improved gate stop to soften closure noise, and enclosed knife-edge life-time pivots.

CHECK THESE BALANCED-34 FEATURES:

- Pre-balanced damper for precise equilibrium, maximum sensivity to draft change.
- New "Pick-Off" adjustment for fast, fine, foulproof, wide-range setting.
- No moving parts to corrode or jam.
- Enclosed knife-edge pivots for life-long sensitive service.
- Heat- and corrosion-resistant vane of finest aluminized steel.
- Improved vane-stop to soften closure noise.
- Newly designed light, durable aluminum frame.

WRITE TO WALKER NOW at the address below for full details on the new BALANCED 34 and for full catalog of WALKER Draft Control products.

ROYAL PURPLE Regulator for smaller central heating plants

SHUR-FLO Inducer-Regulator for gas, oil and solid-fuel plants

JUNIOR LINE for central heating budget control

TYPE BB commercial and industrial control

DOUBLE SWING for gas-fired equipment

VENTURI CAP for heating and ventilating

WALKER MANUFACTURING AND SALES CORP. 1720 Penn St., St. Joseph, Mo.

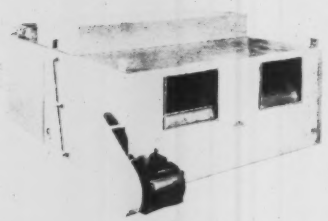
USAIRCO

Air Handling Units

Extra, Built-In QUALITY

. . . For Year-In, Year-Out Performance . . .

10 years experience in the design and manufacture of dependable equipment adds extra quality . . . and this extra quality adds extra durability and longevity to the performance of every USAIRCO product.



"SECTIONAL" Air Conditioner

Models BC & BH

Available in sizes ranging from 800 CFM to 28,000 CFM with a wide variety of discharge arrangements.

WRITE TODAY

USAIRCO

FOR PRODUCT BULLETIN NUMBER 73 & 74

United States Air Conditioning Corporation

Delaware, Ohio

WHO'S WHAT

Continued

▸ *REMINGTON CORP.*—Brownell Associates, Inc., sales representatives for air conditioning products, metropolitan New York.

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—regional sales managers appointed vice presidents: Fred Kaiser, Eastern region; C. L. Peterson, Central region; T. S. Carley, Midwest region.

▸ *WORTHINGTON CORP.*—R. N. Franz, manager, southern resale region of Atlanta, New Orleans, Houston, Dallas, Tulsa; F. J. Reardon, resale manager, Central States.

▸ *NORMAN PRODUCTS CO.*—Harold D. Steffy, eastern sales manager; W. A. McLemore, western sales manager.

▸ *AIRTEMP DIV., CHRYSLER CORP.*—Hascal Simmons and Donald C. Degen, branch manager and sales engineer, respectively, Atlanta, Ga.; George A. Godfrey, district manager, Chicago area.

▸ *WELBILT AIR CONDITIONING & HEATING CORP.*—Halsey Supply Co., franchised representative, Brooklyn, N.Y.

▸ *BARNEBEY-CHENEY CO.*—David Fried and L. V. Appleby Co., sales representatives in New Orleans, La., and Albany, N.Y., respectively.

▸ *TEXAS INSTRUMENTS, INC., Metals & Controls Div.*—field engineers appointed: Samuel T. Bryant, Dayton-Cincinnati area; Robert S. Byers, Chicago area; Robert L. Paul, southern California area.

▸ *SOUTHWEST MFG. CO.*—Hamada Refrigeration Sales Co., representatives for the state of Hawaii.

▸ *STEWART-WARNER CORP., Heating & Air Conditioning Div.*—Warren H. Melgaard and Harry Y. Radine, district sales managers for Wisconsin-northern-Illinois and Detroit-surrounding counties, respectively.

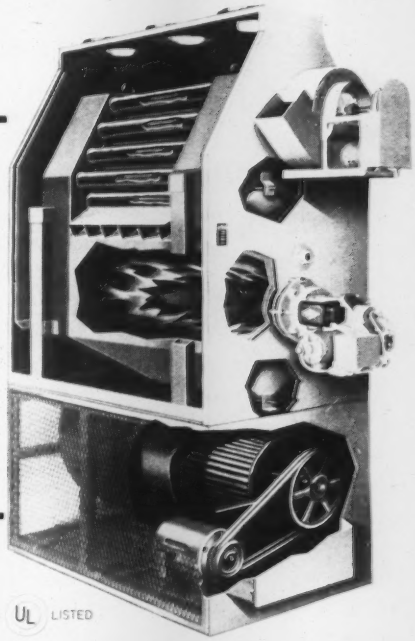
▸ *MUELLER BRASS CO.*—Robert M. Wheeler, sales representative, Philadelphia, Pa.

arkos ... for quality engineering

... performance ... efficiency!

CHECK THESE IMPORTANT FEATURES

- ★ Diamond-shaped stainless steel combustion chamber with true floating four point suspension
- ★ NAFM Certified blowers
- ★ Power-rated burner for Gas, Oil, or combination fuels
- ★ Steel radiation shield
- ★ Lifetime permanently lubricated bearings
- ★ Unitized welded structural steel construction throughout
- ★ Vibration eliminators on all suspended units
- ★ Centralized control cabinet
- ★ High CFM
- ★ Low blower RPM
- ★ Low Blower horsepower
- ★ Wired, assembled and flame tested prior to shipment
- ★ Independent blower support
- ★ Ten year heat exchanger warranty
- ★ 80% guaranteed efficiency



★ **ARKOS Heaters provide dependable yet inexpensive means of heating plants, warehouses, enclosed docks, churches, schools, and are suitable for space heating, make-up air, and drying applications.**

UNDERWRITERS UL LISTED

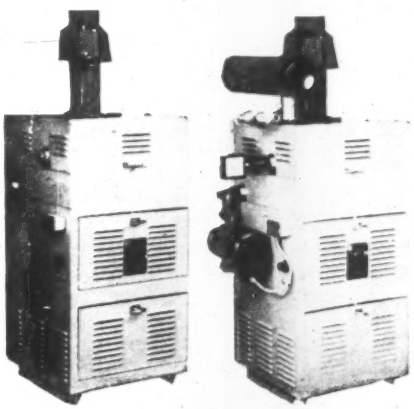
ARKOS Manufacturing Company

7310 Woodward Avenue — Detroit 2, Michigan

Join the trend to HYDRONICS and RAYPAK the inseparable companions.

Raypak, America's most advanced gas-fired boiler line is moving ahead at a rapid pace — now features 9 sizes complete to 1,200,000 BTU/HR — more sizes coming.

Take your choice of the standard -T model or the packaged -TP model.



Raypak also manufactures swimming pool heaters, storage tanks and coils, heat exchangers and accessories.

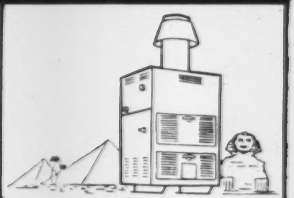
HEART OF THE HOUSE

B H C

MEMBER BETTER HEATING-COOLING COUNCIL

MODULATING GAS VALVE

Holds precise water temperatures — eliminates start and stop noise — saves fuel.



LIFETIME STAINLESS STEEL BURNER

Performance second to none.

LIGHT AND COMPACT

One man installation — saves space.

FINEST MATERIALS

Solid 100% copper and bronze waterways — fastest controlled heat transfer on the market.

A few territories are still available to qualified manufacturers representatives.

Raypak COMPANY, INC.

® Engineers-Manufacturers — 2816 CHICO AVENUE, EL MONTE, CALIFORNIA

DAVIDSON

LOW PROFILE

HIGH CAPACITY low velocity roof fan

PC PLEASING CONTOUR MODEL

New and streamlined . . . designed for today's modern flat roof structures . . . as much as 40% lower than conventional types . . . capacities up to 50,000 CFM . . . low velocity . . . vibration isolated . . . ratings conform to Standard Test Code.

DAVIDSON, first in the field, has been making a complete line of industrial and commercial roof fans since 1915. For information on the PC or other HYDUTY Davidson fans, write to

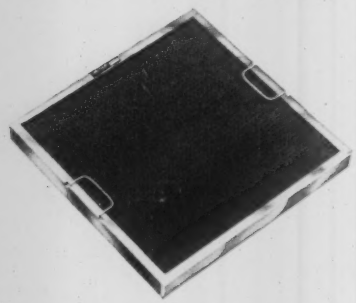
Charter Member AMCA

DAVIDSON FAN CO.

213 California St., Newton 58, Mass.

HIGH VELOCITY AIR FILTER PANELS

all-metal, permanent, washable panels for ventilating and air conditioning systems.



Turboflow action of these filter panels handles 50% more air (up to 3 cfm per square inch gross area) than conventional panels, with high filtering efficiency up to 600 fpm face velocity.

This P-5 Air-Maze panel filter has low static pressure drop, extra large dirt-holding capacity, requires less servicing than ordinary filter panels.

All-metal media of the P-5 has layers of crimped wire screen with "Z" channels stacked 180° to each other so only the nodes touch. Result is a myriad of passages that provide high turbulence by sharp diversions in air stream, causing highly effective wiping action to impinge dirt on adhesive coated baffles.

Write for Bulletin P5-157. AIR-MAZE CORPORATION, Department HP-4, Cleveland 28, Ohio. (Subsidiary of ROCKWELL-STANDARD Corporation)

MEETINGS & CONVENTIONS

APRIL 21-22—*Heat Transfer Conference.* Oklahoma State University, Stillwater, Okla. Oklahoma State University Engineering Dept. Information: Office of Engineering and Industrial Expansion, OSU.

APRIL 25-29—*American Welding Society, annual meeting and exposition.* Los Angeles. Information: American Welding Society, 33 W. 39th St., New York 18.

APRIL 27-30—*Western Air Conditioning, Heating Ventilating and Refrigeration Exhibit and Conference.* Shrine Exposition Hall, Los Angeles. Information: Western Air Conditioning Industries Association, 3443 S. Hill St., Los Angeles 7.

MAY 9-12—*Instrument Society of America, 2nd Instrument-Automation Conference and Exhibit.* Civic Auditorium and Brooks Hall, San Francisco, Calif. Information: Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

MAY 9-12—*Mechanical Contractors Association of America, Inc., annual convention.* Waldorf-Astoria Hotel, New York City. Information: Mechanical Contractors Association of America, Inc., 45 Rockefeller Plaza, New York 20, N. Y.

MAY 11-14—*The Fluid Controls Institute, Inc.,* Spring meeting. The Greenbriar, White Sulphur Springs, W. Va. Information: E. R. Rath, Executive Secretary, P.O. Box 667, Pompano Beach, Fla.

MAY 22-26—*Air Pollution Control Association, 53rd annual meeting.* Netherland-Hilton Hotel, Cincinnati, O. Information: APCA Annual Meeting, 2400 Beekman St., Cincinnati 14, O.

JUNE 5-9—*9th National Plastics Exposition and SPI National Conference,* sponsored by the Society of Plastics Industry, Inc. Exposition: Coliseum, New York City. Conference: Commodore Hotel, New York City. Information: The Society of Plastics Industry, Inc., 250 Park Ave., New York 17.

JUNE 6-9—*National District Heating Association 51st annual meeting.* Grove Park Inn, Asheville, N.C. Information: National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.

JUNE 13-15—*American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., annual meeting.* Vancouver, B.C., Canada. Information: American Society of Heating, Refrigerating and Air-Conditioning Engineers, 62 Worth St., New York 13, N. Y.

QUICK, NEAT METHOD

For Installing Duct Insulation

Shuford's SHURTAPE® MP-26

Metallized Paper Insulation Tape

Here's a low-cost, time-saving method for holding insulation to duct work. In place of staples, use Shuford's SHURTAPE MP-26!

Equally useful for holding insulation and for sealing joints of metal or fibre duct, this silver-colored tape is inexpensive and easy to apply . . . provides an inconspicuous, positive seal with a neat finished appearance.

SHURTAPE MP-26 is designed especially for use in heating and air conditioning installations, and is treated with flame-inhibiting chemicals to retard inflammability. It has a very low moisture vapor transfer rate, excellent resistance to water and abrasion, and also resists solvents and oils.

Write for complete information to

Shuford Mills, INC SINCE 1880
HICKORY, N. C.

CLOTHES LINES • TWINES
PRESSURE-SENSITIVE PAPER TAPES
SASH CORDS • WEATHER STRIPPING
COTTON & RAYON YARNS • EXTRUDED PLASTICS

World's Largest Manufacturer of Cotton Cordage

4751

DURO-DYNE DRILL SCREWS

Win Acclaim of Sheet Metal Men From Coast-to-Coast!

official estimates of State-by-State popu
lation in 1959, made recently by the

If You haven't started using DRILL SCREWS You're still wasting valuable time and money in drilling or punching holes in sheet metal!

DRILL SCREWS™ *drill their own holes!*

Write now for details and FREE SAMPLES

ANOTHER FIRST FROM

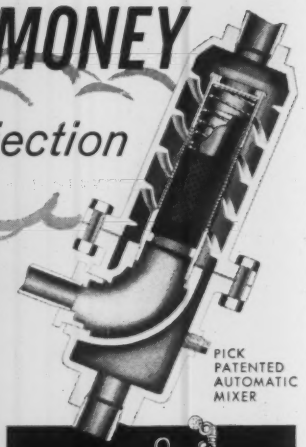
DURO DYNE

The Greatest Name in Sheet Metal Specialties

DURO-DYNE CORPORATION
Farmingdale, New York

SAVE BIG MONEY

Steam Injection



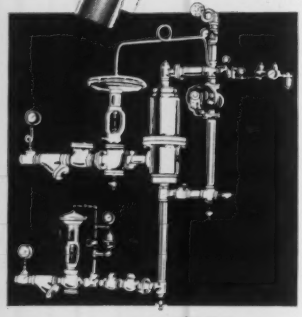
INSTANTANEOUS
HOT WATER
FASTEST, MOST ACCURATE

8 SIZES — 500 TO 50,000 GALS. PER HOUR

New jobs . . . old ones requiring modernization — nothing compares with a Pick heater!

Live steam mixed with water, only as water is drawn. All of the heat of steam is used — none wasted on keeping stored water at correct temperature. Temperature maintained within 3° plus or minus. Volume adjustable from 5% to full rated capacity. 20-second reaction to desired up-and-down changes in water temperature.

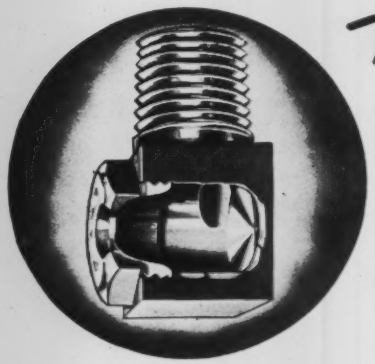
Operates on low or high pressure steam. Uses no floor space; usually attached to wall.



Write today to Dept. N

PICK MFG. CO., West Bend, Wis.

Pick WATER HEATERS



Monarch

NOZZLES
for
AIR WASHERS

These are "non-clogging" nozzles with a single large tangential lead hole to the swirl chamber that will never clog from any impurities small enough to pass through the orifice. Swirl chamber is conical on both ends and pivots liquid like a top to produce an exceptionally fine, evenly distributed, balanced spray of about 80° included angle. Wider spray angles up to 130° can be furnished to order.

Standard material Brass. Also available in Stainless Steel and Monel. Pipe sizes from 1/8" to 1". 1/4" size is 1-5/16" long and made from 5/8" square stock.

Write for Catalog 1

Monarch MFG. WORKS, INC.
2523 E. ONTARIO ST.
PHILADELPHIA 34, PA.

Canadian Agents: (Except B. C.)
E. S. Gallagher Sales Ltd., Toronto 12, Canada

MEETINGS & CONVENTIONS

Continued

JUNE 20-24—*American Society for Engineering Education, 68th annual meeting.* Purdue University, Lafayette, Ind.

JULY 25-29—*13th International Congress on Occupational Health.* Waldorf-Astoria Hotel, New York. Information: Dr. Leo Wade, 15 W. 51 St., New York, N.Y.

SEPT. 7-9—*Joint Automatic Control Conference.* Massachusetts Institute of Technology, Cambridge, Mass.

OCT 12-15—*Cast Bronze Bearing Institute and Non-Ferrous Founders' Society annual meetings.* Grove Park Inn, Asheville, N.C. Information: Non-Ferrous Founders' Society, 1604 Chicago Ave., Evanston, Ill.

OCT 17-21—*48th Annual National Safety Congress.* Industrial safety sessions, Conrad Hilton, Pick-Congress, Sheraton Towers, Morrison, and La Salle hotels, Chicago. Information: R. L. Forney, secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

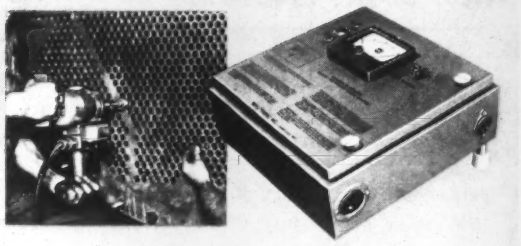
NOV. 28-*DEC.* 2—*21th National Exposition of Power and Mechanical Engineering.* Under auspices of the American Society of Mechanical Engineers. New York Coliseum. Information: International Exposition Co., Inc., 480 Lexington Ave., New York 17.

NEW BOOKS & REPORTS...

Chemical Processing of Irradiated Fuels—155 pp. Proceedings of the Atomic Energy Commission Symposium, October, 1959; with illustrative material. Office of Technical Services, Dept. of Commerce, Washington 25, D.C. $4.50

Architectural Rendering: The techniques of contemporary presentation—277 pp. by Albert O. Halse, A.I.A.; illustrated. F. W. Dodge Corp., 119 W. 40th St., New York 18, N.Y. $15.75

Gas Shielded-Arc Welding—78 pp., illustrated. American Welding Society, 33 W. 39th St., New York 18, N.Y. $1.50



Your Motor + Wiedeke Torque Control = Increased Tube Rolling Production

Save the cost of a new motor! New Torque Control Instrument for rolling ¼" through 4½" tubes in boilers, condensers and similar heat transfer vessels—operates with any Universal Reversible Electric Tube Rolling Tapper or Motor. Adjustable time cycle matches operator's dexterity.

WRITE TODAY FOR DETAILS AND BULLETIN AC-7A

The Gustav WIEDEKE Company
Dayton 1, Ohio

CLEAN AIR IS PROFITABLE AIR!

AFI MEMBER — AIR FILTER INSTITUTE

Clean air, free of dirt and dust particles, reduces operating costs, increases employee efficiency. Be sure to provide for clean air in your installations — and remember, the finest filters are sold by members of the Air Filter Institute . . .

Box 9325, Washington 5, D.C.

Air Devices, Inc.
185 Madison Avenue
New York 16, New York

Air Filter Corporation
4554 W. Woolworth Avenue
Milwaukee 18, Wisconsin

Air-Maze Corporation
25000 Miles Road
Cleveland 28, Ohio

American Air Filter Co., Inc.
215 Central Avenue
Louisville 8, Kentucky

Continental Air Filters, Inc.
2520 Helm Street
Louisville 9, Kentucky

Dollinger Corporation
11 Centre Park
Rochester 3, New York

Drico Industrial Corporation
100 Eighth Street
Passaic, New Jersey

Fram Corporation
Providence 16, Rhode Island

Minneapolis-Honeywell Regulator Co.
Minneapolis 8, Minnesota

Owens-Corning Fiberglas Corporation
1833 National Bank Building
Toledo 3, Ohio

Pittsburgh Plate Glass Company
Fiber Glass Division
One Gateway Center
Pittsburgh 22, Pennsylvania

Research Products Corporation
1015 E. Washington Avenue
Madison 10, Wisconsin

*Technical Filter Co.
2719 South Poplar Avenue
Chicago 8, Illinois

Trion, Inc.
1000 Island Avenue
McKees Rocks, Pennsylvania

Vortox Company
121 S. Alexander Avenue
Claremont, California

Westinghouse Electric Corporation
Sturtevant Division
Hyde Park, Boston 36, Massachusetts

*Formerly Wilson & Co., Inc.

Cut assembly time with KEY-TITE®, the tight sealing waterproof pipe joint compound. It's ideal for water, gas and low pressure lines — safe for potable liquids — contains no toxic ingredients. Actually lubricates while it seals — joints don't freeze.

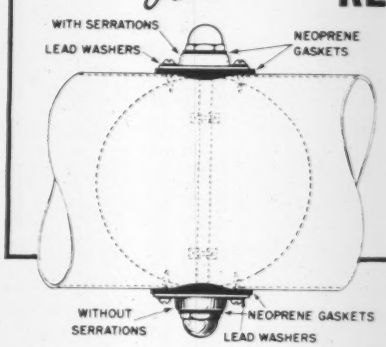
Key-Tite is easy to apply with a brush — no crumbling or waste. Extra long open-can life eliminates thinning and stirring.

Available in the following sizes: ⅛ pint, Handy Dope Kit, ½ pint, 1 pint, quart, 1 gallon and 5 gallon cans and 500 lb. drums.

WRITE FOR CIRCULAR 239-B AND FREE SAMPLE

W-K-M DIVISION OF ACF INDUSTRIES INCORPORATED
Dept. BB-04, P. O. 2117, HOUSTON TEXAS

NEW *Young* DAMPER REGULATOR



withstands pressures to 50 psi

This damper regulator, Model 409RD with #419RD end bearing, is designed specifically for ducts carrying high pressures or low vacuums.

The unit is capable of withstanding pressures of 50 lbs. per sq. inch without leakage. It is easily installed in round ducts from 4" to 8" in diameter.

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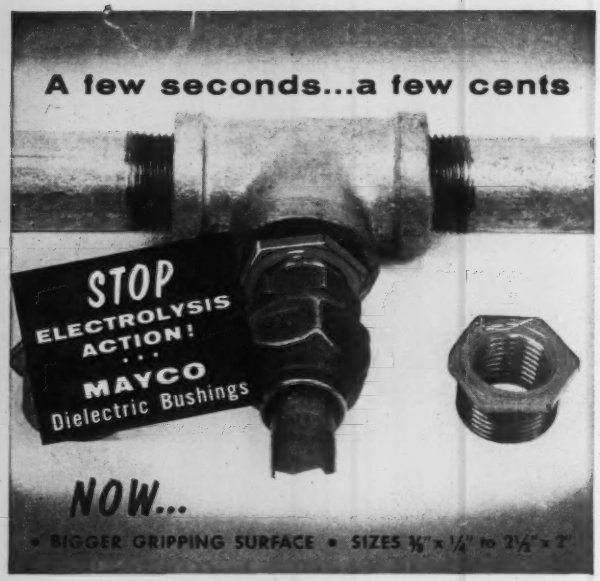
See our catalog in Sweet's Architectural File.

YOUNG REGULATOR COMPANY
20910 Miles Ave., Cleveland 28, Ohio



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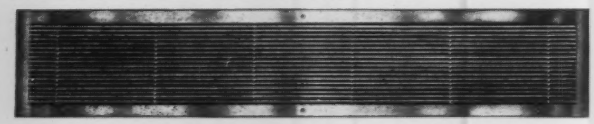

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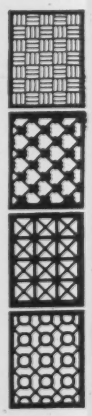

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ASTM Standards on Methods of Atmospheric Sampling and Analysis—116 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $2.25 or $1.80 to members.

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—The Pipe Fabrication Institute, Room 759, 1 Gateway Center, Pittsburgh 22, Pa.

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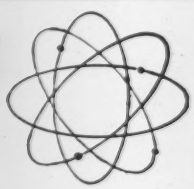

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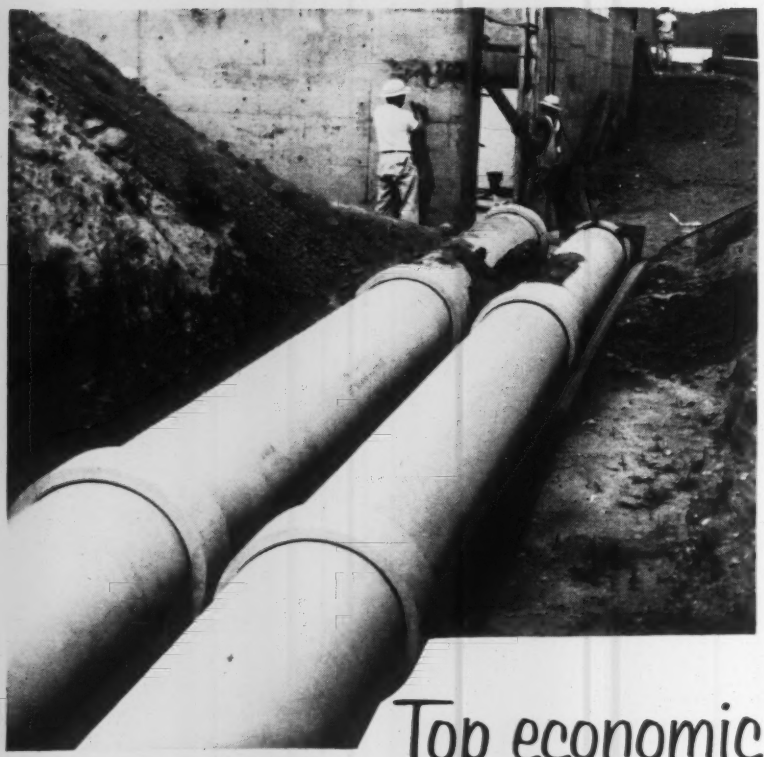

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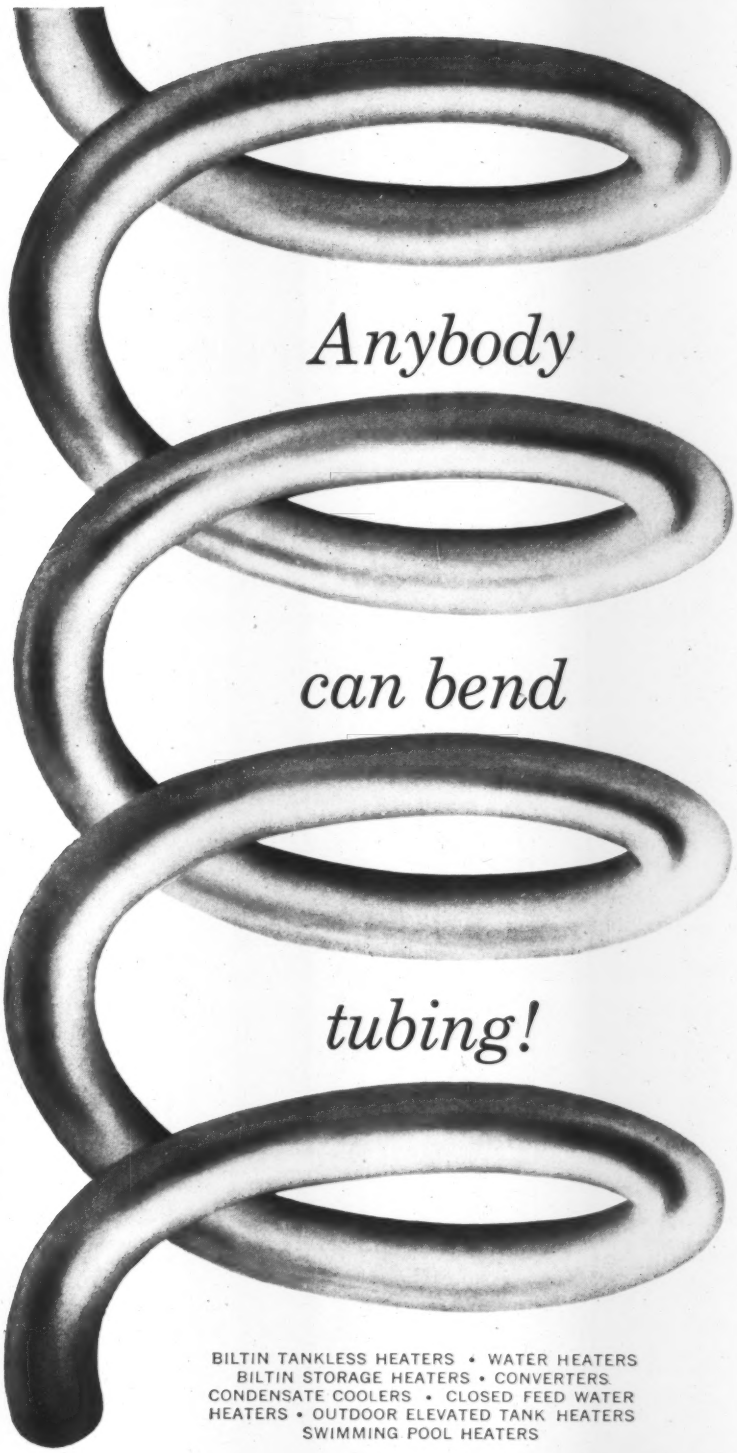

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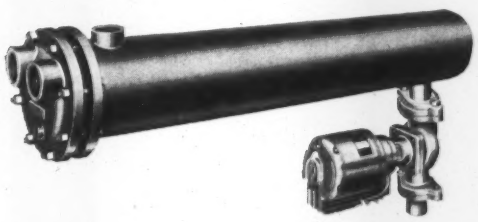

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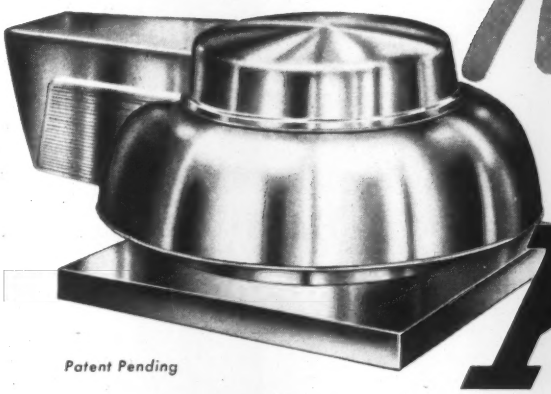

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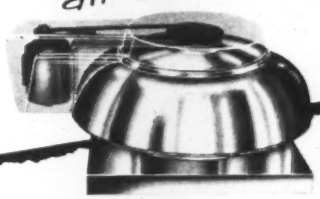

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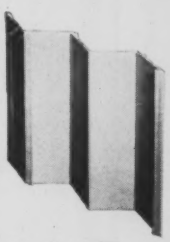

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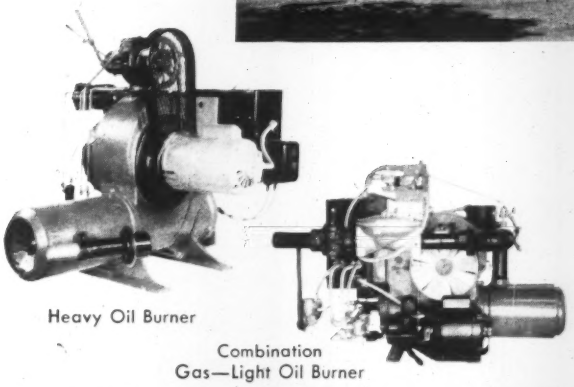

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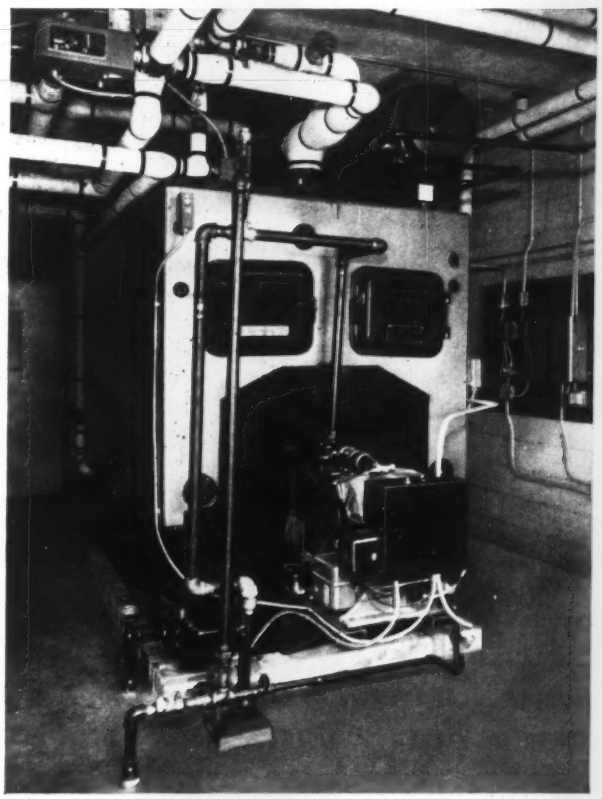
Gas—Light Oil Burner



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Send for Bulletin C-272. For information on other Weil-McLain Gas and Oil Boilers, see Engineers' Product File or Sweet's Architectural File.

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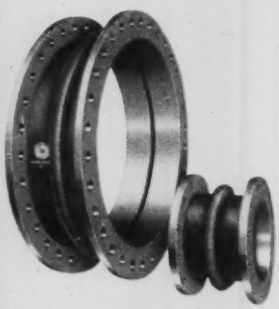

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- NO FLEX-CRACKING
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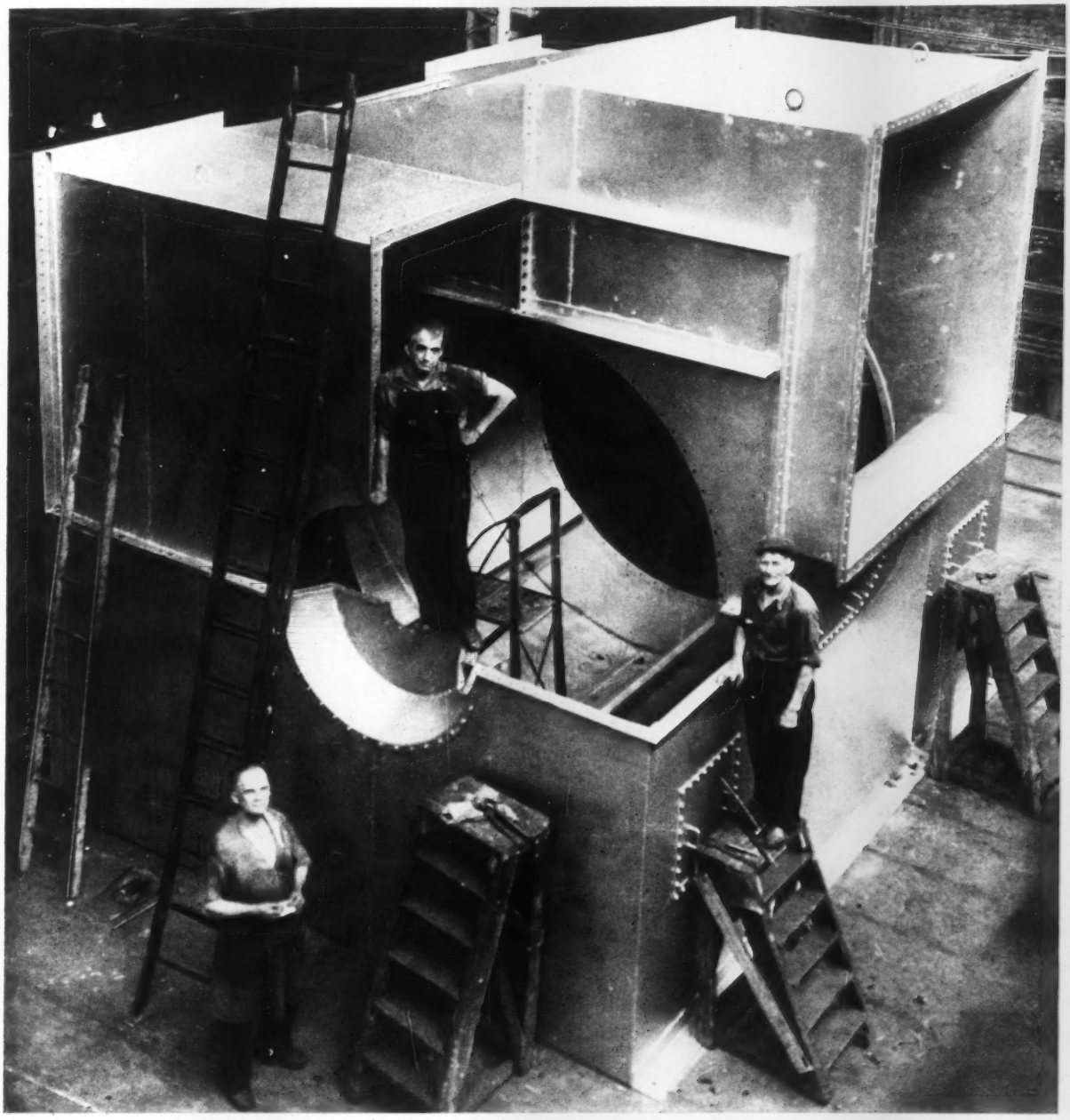

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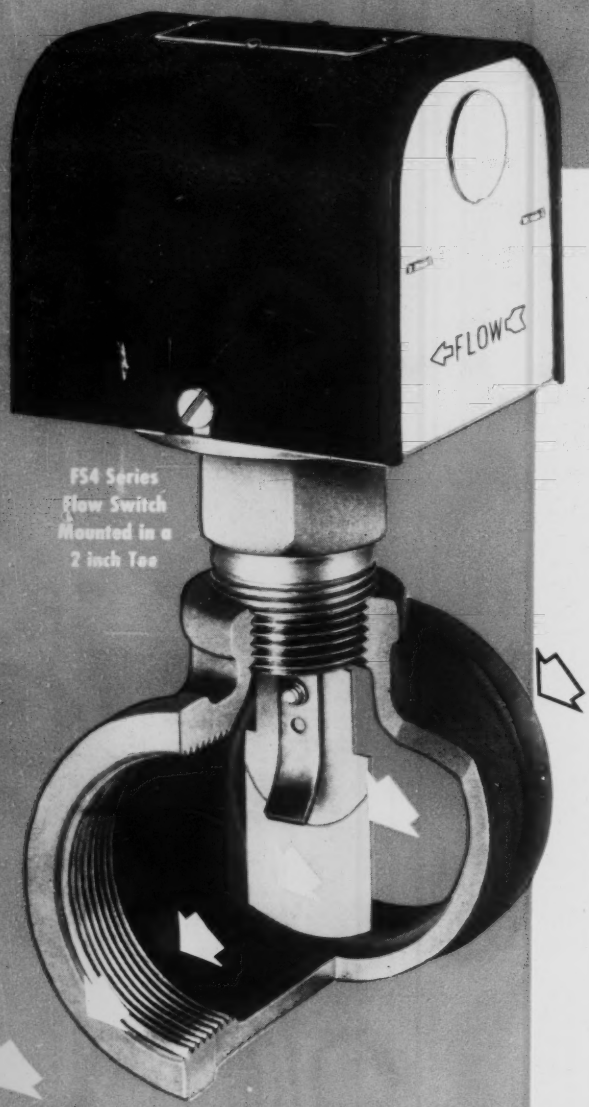
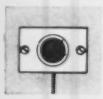
McDONNELL
Flow Switches



FS4 Series Flow Switch Mounted in a 2 inch Tee

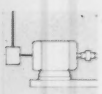
Do you know how many jobs these switches can do?

Look at the FS4 Series Flow Switch illustrated here. What you see is a compact, well-built switch that either makes or breaks a circuit (as required) when liquid flows or stops flowing. Yet in this versatile device you have both the most economical way and the most positive way of starting or stopping a signal, an alarm, a motor, a metering device—anything electrically operated. Just to highlight a few uses:—

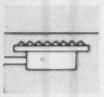


to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.

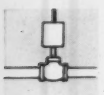
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering devices—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

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FS4 Closes with flow, opens with no flow.

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